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State of California

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Memorandum

Date : September 16, 1996

To : Rod Mayer
Planning, Room 252-18

Koll Buer
Northern District

From : Department of Water Resources

Subject: Provident Irrigation District, Phase I Conjunctive Use Study

This report presents the findings of the Provident Irrigation District Phase I Conjunctive Use Study. It discusses the land and water use, the present surface and groundwater distribution system, hydrogeology, and results of aquifer tests. The report includes a summary of findings and recommendations for further study.

This study concludes that a conjunctive use project appears feasible and that between 30,000 and 45,000 acre-feet of additional water supply could be made available during dry years by substituting groundwater pumping in lieu of Provident Irrigation District's Sacramento River surface water supply.

However, aquifer tests and our monitoring program show that there is an intertie between the Sacramento River and the local shallow groundwater table. This intertie probably extends to a depth of over 100 feet below ground surface and as far away as one mile on the west side of the river. Beyond the one mile and at depths over 200 feet, the Sacramento River influence appears to be small or nonexistent and the regional northwest to southeast groundwater gradient seems to be the primary influence on groundwater elevations.

This study is part of the Groundwater Development Element of the State Water Project Future Supply Program. The report was prepared by Koll Buer, Senior Engineering Geologist, with assistance from Sandy Irving, Technician II, Dan McManus and Noel Eaves, Associate Engineering Geologists, and Bryton Johnson, Mark Souverville, Denise Jennings, and Kelly Staton, student and graduate student assistants. Northern District's Environmental Engineering Section surveyed the well locations and elevations. The Land and Water Use Section provided land ownership and use information. JoAnne Wright helped with report preparation.

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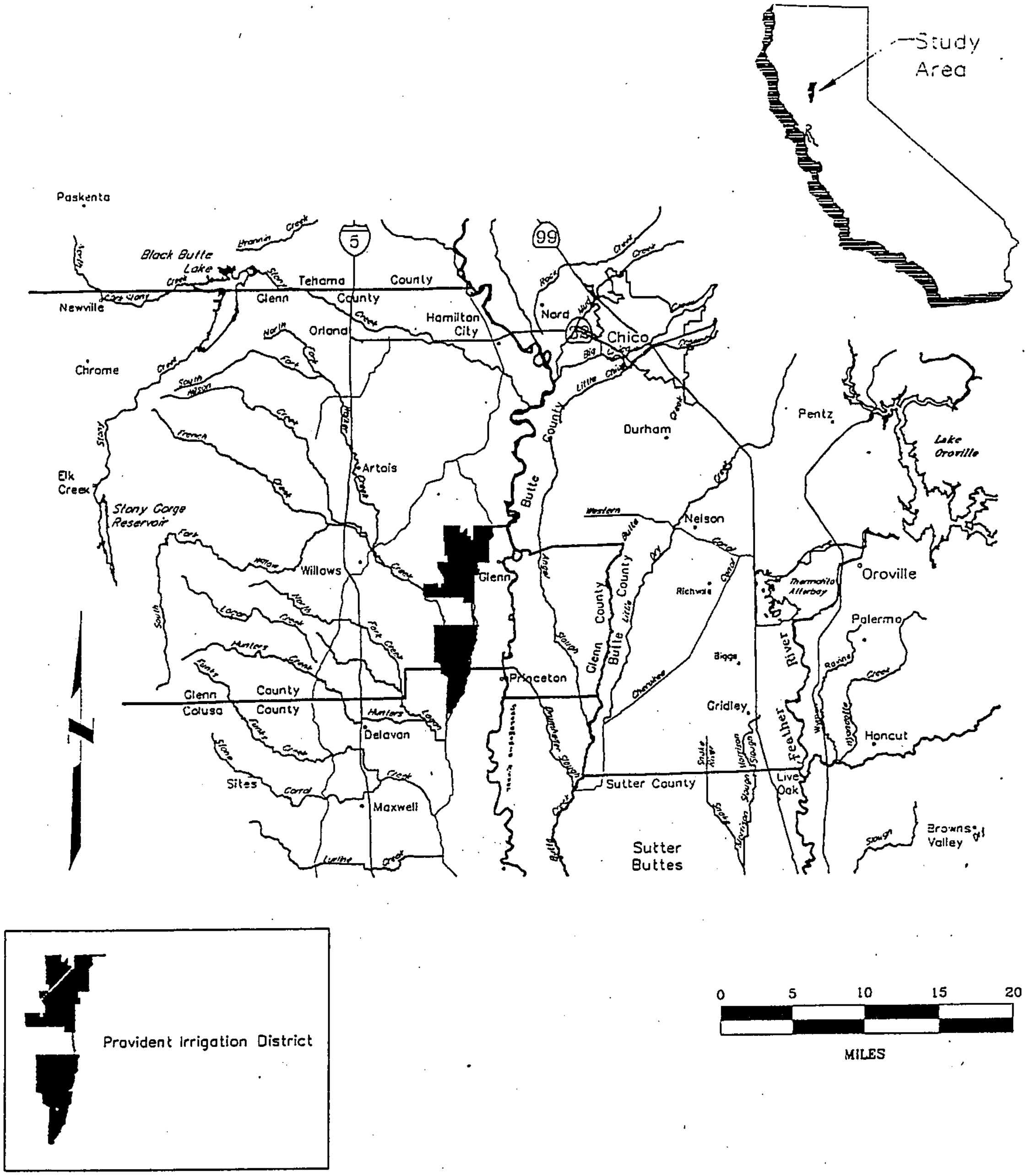

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF LOCAL ASSISTANCE
NORTHERN DISTRICT

LOCATION MAP OF PROVIDENT IRRIGATION DISTRICT
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY

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PROVIDENT IRRIGATION DISTRICT PHASE 1 CONJUNCTIVE USE STUDY

INTRODUCTION

Provident Irrigation District was identified as having good conjunctive use potential in a Northern District Memorandum Report on the *Conjunctive Use Potential of the Sacramento Valley Within the Northern District* (1993). The criteria were developable groundwater resources, substantial surface water use, high degree of surface water supply reliability, degree of existing or potential groundwater development and willingness to participate in a conjunctive use project. PID applies approximately 36,000 acre-feet of Sacramento River water for irrigation per year.

This report includes a brief discussion of the PID, including background information, water conveyance facilities, wells, land use, geology, and hydrogeology. Two pump tests were conducted to further understand the aquifer characteristics of the Tehama Formation and the interrelationship between the groundwater basin and the Sacramento River.

Study Area, Location, Access, and History

The Provident Irrigation District is on the west bank of the Sacramento River near Butte City in Glenn and Colusa Counties in the central part of the Sacramento Valley. The location is shown on ***Plate 1***. The district is characterized by flat, low-lying areas of the Sacramento River floodplain and comprises 15,165 acres of which 14,439 acres are irrigated. The primary crop is rice which accounts for 98 percent of the total irrigated crops grown.

The history of PID and neighboring irrigation districts are related to the original organizations of the old Central Irrigation District, formed in 1887. About half of the Provident lands were included in CID. No water was delivered until 1906, however, because of financial difficulties and several subsequent sales.

The Provident Irrigation Syndicate bought large tracts of land in the area and completed a canal system in 1917 to divert water from the river at Sidds Landing. The next year, the Provident Irrigation District was formed under the Irrigation District Act. PID is also part of the large Reclamation District 2047 and is bounded by the Princeton-Codora-Glenn ID to the east and the Glenn-Colusa ID to the west. The district is accessible by State Highways 45 and 162.

Purpose and Scope

The purpose of this Phase I study is to determine if Provident Irrigation District is a possible conjunctive use project with inlieu substitution of groundwater for surface water to augment the State's water supply during periods of drought. Conjunctive use is the planned use and management of both groundwater and surface water to increase the usable water supply available over that available if the two resources are treated independently. To some extent this occurs without deliberate action because surface water and groundwater are hydraulically interconnected. Carefully planned and operated projects will increase the available water supply without interfering with existing water rights and uses.

PID was selected as a possible conjunctive use project because of the existence of a surface water conveyance system, a pre-existing Sacramento River water right, and a number of groundwater wells available for pumping groundwater. PID also overlies a productive portion of the Sacramento Valley aquifer system.

The project would operate during periods of drought and limited surface water supply. The district would be paid to pump groundwater for irrigation during these periods, allowing the undiverted surface water to be used downstream. The water table would be allowed to recover during the winter and wet periods either by natural recharge, or the application of surface water on fields or recharge areas.

Methodology

The work program for Phase I of the groundwater study included the following tasks:

- Locate existing wells and establish a monitoring program to determine seasonal changes in groundwater elevations.

- Survey a reference point elevation for each monitoring well to determine location and true elevation.

- Perform aquifer tests to determine aquifer characteristics such as permeability, transmissivity, storativity, etc.

- Qualify the wells in the monitoring grid and construct groundwater elevation maps and hydrogeologic cross-sections.

- Construct geology, land use, well location, land ownership and other maps.

- Determine the interconnection between the Sacramento River and the adjacent groundwater aquifers.

- Determine surface water rights, map the water distribution system, and determine the potential for a conjunctive use program.

The Department of Water Resources established a groundwater monitoring grid consisting of 10 monitoring wells in addition to the eight wells that the Department is already measuring semi-annually in the same general area. The wells were qualified using Well Completion Reports, geologic maps, and information in the Department's Bulletin 118-6 (1978). The ten wells were surveyed using Global Positioning System methodology with an accuracy of about two centimeters. State Well Numbers were assigned to aid in the filing and handling of the data. In this report both the full and partial well numbers will be used. The partial numbers only contain the section, tract, and sequential number (see Appendix A).

Well locations, district boundaries, surface water distribution systems, land ownership, land use, and other data were digitized from topographic base maps of the area and overlaid onto electronic copies of 7.5-minute U.S. Geological Survey maps. Regional geology and aquifer systems were compiled from published reports by the U.S. Geological Survey and DWR and by inspecting Well Completion Reports.

Two pump tests were run on the Provident Irrigation Districts #4 pump. The first was a one-day aquifer test on November 13, 1995 to determine well response in preparation for a more extensive test. The second test lasted for five days of pumping beginning on February 1, 1996 while monitoring ten wells and water levels in the Sacramento River.

Water Supply, Water Districts, and Agricultural Water Demand

PID is irrigated by both surface and groundwater. The primary water source is the Sacramento River and agricultural return flow which drains from adjacent irrigation districts. The water sources and quantities have varied historically.

PID's water rights are 11th priority in the California District Irrigation Act of 1917. This act was an amendment of the Wright Irrigation Act of 1887 and the Bridgeford Act of 1897. These acts authorized the creation of irrigation districts and bylaws, assessments, and regulations. It also specified that compensation had to be paid to anyone who had prior right to the water. This proviso was overturned in 1935 by the State Supreme Court which established the rule of reasonable use.

The water right varies according to the month. There are four separate Sacramento River Water rights permits from the State of California Water Commission. These are Permit 303 for 250 cubic feet per second dated 1916, Permit 304 for 100 cfs dated 1917, Permit 416 for 110 cfs dated 1918 and Permit 494 for 200 cfs dated 1918. Each one of these permits indicate seven alternate points of diversion, including Sidds Landing, the Glenn-Colusa Irrigation District river pumping plant and five others on drains entering the District.

The district also has 5,000 acre-feet of U.S. Bureau of Reclamation Project water as shown in ***Table 1***. This was contracted for on April 6, 1964 with a contract renewal due on April 6, 2004. A river pumping plant is at Sidds Landing on the Sacramento River levee about 10 miles east of Willows. The pumping plant consists of a set of six pumps with a combined capacity of about 300 cubic feet per second.

PID also has a contractual obligation to furnish the Willow Creek Mutual Water Company with water for 750 acres of rice, with surplus water to be used to create duck ponds.

Table 2 shows the Sacramento River Diversions from 1950 to 1996, including summaries and running averages. The average yearly Sacramento River diversion is 36,300 acre-feet with a maximum of about 50,000 and a minimum of about 20,000.

TABLE 1
Provident Irrigation District Water Rights

	April	May	June	July	August	September	October	Total
Base	7,210	10,830	12,920	6,300	2,500	7,400	2,570	49,730
Project				3,500	1,000	500		5,000
Total	7,210	10,830	12,920	9,800	3,500	7,900	2,570	54,730

The surface water distribution system, shown In ***Plate 1***, consists of 30 miles of main canal and 60 miles of lateral ditches, all of which are unlined. Concrete structures are at most turnouts and control points. Water is moved to the fields using both pumps, gates, and siphons.

The main canal, with a capacity of about 550 cubic feet per second, extends due west about 2.5 miles from the Sacramento River and then turns south, following high ground along the west side of the District. After crossing Willow Creek, it extends southerly to serve the District's lower part. Here it divides into three main laterals. A booster plant lifting water eight feet into the main canal is on the Districts northwest side. Two other booster plants are operated by the District and a third is operated by a private landowner.

The district presently operates eight drain water recirculation diversions by both gravity and pumps. During the drought of 1976-77, the district installed three agricultural wells to supplement its water supply. An additional well was installed in 1991. During the 1986-1992 drought, several private wells were installed (Borcalli and Associates, 1995).

TABLE 2
SACRAMENTO RIVER DIVERSIONS

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	Apr-Sep
1950	0	0	474	1,905	0	0	2,515	3,521	3,186	3,546	3,953	782	19,882	17,503
1951	0	485	0	0	0	182	4,806	10,322	9,521	10,221	9,037	753	45,327	44,660
1952	0	1,900	0	0	0	0	1,903	7,974	5,000	5,201	5,069	2,582	29,629	27,729
1953	0	700	0	0	0	0	5,420	7,676	6,005	7,972	4,947	2,241	34,961	34,261
1954	0	0	2,651	454	0	0	612	8,990	7,156	9,728	6,429	1,974	37,994	34,889
1955	0	52	1,455	212	0	0	3,155	3,503	5,238	5,759	5,655	1,195	26,224	24,505
1956	0	255	1,304	0	0	0	3,133	6,677	5,911	6,162	6,225	1,581	31,248	29,689
1957	0	2,281	2,606	0	0	0	7,340	5,548	7,115	7,307	6,670	809	39,676	34,789
1958	1,152	2,500	1,630	0	0	0	877	6,100	5,550	5,870	3,520	939	28,138	22,856
1959	0	0	0	0	0	0	8,490	2,850	4,990	5,780	4,160	0	26,270	26,270
1960	0	0	0	0	0	0	5,790	2,770	8,180	7,380	6,220	103	30,443	30,443
1961	0	106	2,040	0	0	0	5,640	4,220	4,960	7,040	3,640	0	27,646	25,500
1962	0	0	1,720	269	0	0	6,200	3,580	5,000	5,800	4,630	160	27,359	25,370
1963	1,450	4,910	3,270	0	0	0	107	3,510	2,980	2,670	2,460	373	21,730	12,100
1964	642	3,120	4,320	0	0	0	8,140	724	2,430	2,340	2,040	0	23,756	15,674
1965	582	2,120	2,950	232	0	0	4,480	4,650	2,890	4,060	2,310	1,220	25,494	19,610
1966	1,140	1,520	3,800	0	0	0	9,900	4,320	5,770	5,770	3,100	11	35,331	28,871
1967	2,010	1,360	1,340	86	0	0	0	6,663	4,484	6,516	5,189	656	28,301	23,505
1968	2,012	2,437	2,473	0	0	0	9,598	4,182	6,164	5,120	2,004	336	34,326	27,404
1969	1,540	3,052	2,254	0	0	0	7,839	8,932	7,011	6,006	5,155	651	42,440	35,594
1970	3,227						11,192	7,365	6,855	5,908	4,908	1,496	40,951	37,724
1971	1,714						10,091	6,491	7,507	7,746	4,961	263	38,773	37,059
1972	1,670						9,086	7,203	8,825	7,654	4,697	547	39,682	38,012
1973	1,394						4,346	10,392	8,899	9,309	8,748	4,026	47,114	45,720
1974	87						5,908	12,266	9,441	8,468	5,062	1,039	42,271	42,184
1975	2,290						6,748	9,923	12,333	10,441	6,895	2,105	50,735	48,445
1976	1,499						8,199	10,756	10,957	9,641	6,902	1,205	49,159	47,660
1977	1,802						10,442	3,282	8,056	6,119	5,017	1,077	35,795	33,993
1978	1,095						3,511	11,729	11,288	11,704	7,788	433	47,548	46,453
1979	1,695						7,252	8,855	12,048	12,456	8,684	735	51,725	50,030
1980	1,169						6,947	6,047	10,383	10,358	7,463	781	43,148	41,979
1981	1,490						5,222	10,505	13,380	9,790	6,977	1,161	48,525	47,035
1982	1,712						429	10,864	11,180	9,705	5,988	1,245	41,123	39,411
1983	2,517						0	8,026	8,699	9,205	7,956	2,822	39,225	36,708
1984	2,447						6,063	7,035	11,093	8,679	3,515	843	37,675	35,228
1985	2,700						3,077	10,643	10,955	11,872	9,185	930	49,362	46,662
1986	1,497						3,071	9,116	10,772	11,059	7,787	684	43,986	42,489
1987	1,507						4,477	5,452	7,616	8,067	5,446	566	33,131	31,624
1988	1,163						4,011	5,429	7,047	9,925	5,933	389	33,897	32,734
1989	933						3,645	6,211	8,682	9,545	4,967	386	34,369	33,436
1990	1,159						5,745	4,385	7,662	8,201	5,501	0	32,653	31,494
1991	789						2,658	4,272	7,259	4,143	3,669	348	23,138	22,349
1992	1,215						2,227	9,550	7,313	5,488	5,790	0	31,583	30,368
1993	2,909						3,415	8,599	9,126	12,847	6,945	0	43,841	40,932
1994	3,313						6,332	5,367	7,186	7,577	3,826	0	33,601	30,288
1995	6,145						1,809	8,552	9,311	8,180	6,609	0	40,606	34,461
1996	6,567													
Avg	1,409	1,340	1,714	158			5,040	6,848	7,683	7,659	5,514	858	36,300	33,602
Max	6,567	4,910	4,320	1,905			11,192	12,266	13,380	12,847	9,185	4,026	51,725	50,030
Min	0	0	0	0			0	724	2,430	2,340	2,004	0	19,882	12,100
50-59 Avg	115	817	1,012	257			3,825	6,316	5,967	6,755	5,567	1,286	31,935	29,715
60-69 Avg	938	1,863	2,417	59			5,769	4,355	4,987	5,270	3,675	351	29,683	24,407
70-79 Avg	1,647						7,678	8,826	9,621	8,945	6,366	1,293	44,375	42,728
80-89 Avg	1,714						3,694	7,933	9,981	9,621	6,522	981	40,444	38,731
90-95 Avg	2,588						3,698	6,788	7,976	7,739	5,390	58	34,237	31,649

The four irrigation wells operated by PID, designated PID#1-4, have a combined capacity of 18,450 gallons per minute, or 41.1 cubic feet per second. These are located along Sidds Road, as shown on ***Plate 1***. There are a number of domestic wells in the district, some of which were used as monitoring wells during aquifer tests. ***Table 3*** is a list of PID wells with locations and capacities.

Many of the landowners also operate their own wells for irrigation or for sale to PID during periods of low water supply. About 30 of these irrigation wells are plumbed to deliver water to the fields or to the PID ditches.

Land Ownership, Land Use, and Irrigation Practices

Plate 2 shows the land ownership. Most of the land has been divided into fairly large parcels. Some of the long elongated parcels are owned by PID along canal routes and are too narrow to show in detail.

Plate 3 maps the land use and cropping pattern for PID. The map includes a table showing the number of acres in each land use category. Because the cropping pattern is primarily rice, flood irrigation is the only significant irrigation method. There are a few houses with domestic wells, and a few people that live within the district. There are no municipalities and no industrial activities.

TABLE 3
Provident Irrigation District Well Capacities

Well	Capacity (gpm)	Elevation of Reference Point	UTM Coordinates
PID #1	2,500	Not surveyed	Not surveyed
PID #2(25J02)	6,300	96.87 feet	4378946.719902, 583671.320390
PID #3(25J03)	5,150	102.6 feet	4378938.715634, 584013.123039
PID #4(30L01)	4,500	100.79 feet	4378949.472392, 584411.809195

Note: Well capacities provided by Provident Irrigation District.

There are no dedicated recharge facilities in Provident Irrigation District. Some amount of recharge to the groundwater does, however, occur from infiltration along creeks, from deep percolation of applied surface water on the fields, and from infiltration or conveyance loss along the district's ditches and canals. Because of the relatively impervious soil and the high water table, it is estimated that most of the water is consumptively used or runs off and only a small part of the of the applied irrigation water enters the water table each year.

SUMMARY OF FINDINGS

The following are the findings of the PID Phase I Conjunctive Use Study:

- The surface geology consists of a combination of relatively impermeable basin deposits and more permeable Modesto Formation. The basin deposits consist of mostly clay and silt ranging in thickness between 10 to 40 feet thick. The Modesto Formation consists of an upper layer of silt and sand five to ten feet thick underlain by sand and gravel ten to 20 feet thick. These two units are part of the unconfined aquifer system but do not directly contribute to yields because of well surface seals.

- The major aquifer in the area is the Tehama Formation consisting of layers of relatively impermeable clays and silts with lenses of coarser silt, sand, and gravel. Overall, the permeability and transmissivity are high, with the average transmissivity ranging from 400,000 to 800,000 gallons per day per foot. The aquifer is for the most part confined or leaky.

- Seasonal fluctuations in the groundwater level are minimal, generally less than about 10 feet. The water table averages about 10 feet below the ground surface over most of the study area but is locally artesian. Long-term hydrographs, shown in Appendix C4, indicate that there are only minor yearly fluctuations and that present groundwater conditions are similar to conditions in the 1930s.

- California's extended 1986-1992 drought had minimal impacts on the area's water table with water levels remaining an average of about 10 feet below ground surface.

- DWR's 1993 land use survey shows that of the 15,165 acres of irrigated land, 13,582 were in rice with the remainder in grass, fallow, or others. Out of the total irrigated acres, the large majority was irrigated by surface water with smaller parts by groundwater and recirculated water.

- PID has surface water rights that includes 49,730 acre-feet per year from the River Irrigation Act of 1917 and 5,000 acre-feet of U.S. Bureau of Reclamation Project water. In addition, PID draws irrigation return flow from the Colusa Basin Drain.

- The geologic map shows that potential recharge areas occur in the district boundaries, mostly along ephemeral streams and on older Modesto Formation deposits. The basin deposits are generally too impermeable to be effective recharge areas.

- The two aquifer tests show that well yields and aquifer transmissivity are high, ranging from 400,000 to 800,000 gallons per day per foot in the area within one mile west of the river.

CONCLUSIONS AND RECOMMENDATIONS

The following are conclusions developed from the Provident Irrigation District Phase I Conjunctive Use Study:

- Aquifer tests and the monitoring program show that there is an intertie between the Sacramento River and the local shallow groundwater table. The intertie appears to range to a depth of over one hundred feet and extend as far away as one mile on the west side of the river. Sustained pumping in this zone reverses the regional northwest to southeast groundwater gradient and induces recharge to the local groundwater basin. Beyond the one mile and at depths over 200 feet, the Sacramento River influence appears to be much less or nonexistent and the regional northwest to southeast groundwater gradient seems to be the primary influence on groundwater elevations.

- The study results suggest that a conjunctive use project is feasible. However, extraction wells should be drawing from aquifers deeper than 200 feet and/or more than one mile from the Sacramento River to reduce interference with surface water supplies.

- A conjunctive use project with PID could realize an average increased yield of about 30,000 acre-feet but up to about 45,000 acre-feet during dry years by substituting groundwater pumping for Sacramento River surface water diversions.

- Potential recharge areas in Modesto Formation and Recent alluvial deposits seem feasible. These areas are more permeable than the basin deposits. The recharge areas could also be modified to serve as wildlife mitigation areas.

- The spring and fall groundwater contours show the flow to be in the same general direction. The water levels are somewhat lower in the fall, however. The flow gradient is about 0.0010. Near the Sacramento River the gradient decreases to about 0.0003 and the groundwater flow direction is nearly parallel to the river. A spring to fall groundwater change map shows a 16-foot depression in the fall water table that disappears by the spring because of winter recharge. This suggests that adequate recharge occurs in the area.

- There are few domestic and irrigation wells in the area suggesting that problems with well interference will be minimal.

- There is probably over 200 cubic feet per second of groundwater extraction capacity between PID's four irrigation wells and about 30 private irrigation wells available to the district for water supply.

We recommend that Phase II of the Provident Irrigation District Conjunctive Use Study be instigated. The general goals of the Phase II Study would be to better define the western PID hydrogeology, set up a monitoring grid, install monitoring wells, design a project, determine project yields, and define institutional limitations. The scope and time line for the proposed Phase II study is shown in ***Plate 4***. In general, Phase II project recommendations would include:

- Develop a computer model to model aquifer characteristics and estimate percent yield from the upper and lower zones.

- Develop estimates for aquifer permeability, transmissivity, well yields for the more western parts of PID. Conduct pump tests for wells farther from the Sacramento River. Drill a test well if none are available. The location and construction of the well should be suitable for conversion to a production well.

- Install monitoring wells in the parts of the district where no monitoring wells are presently available. Begin a monitoring program that encompasses the entire district including the southern part.

- Develop a conceptual design for a well field and surface conveyance capable of substituting for current surface water supplies. Develop capital and operating cost estimates for the required facilities.

- Evaluate impacts of a conjunctive use program on other water users and develop recommendations for monitoring and mitigation of impacts.

- Perform an environmental assessment to determine needed CEQA, NEPA, and Endangered Species Act documentation. Determine needed Department of Fish and Game Stream Alteration Agreements, county use permits, U.S. Corps of Engineers 404 and Section 10 permits, and Reclamation Board permits.

- Prepare an evaluation of any institutional relationships and\or possible constraints resulting from a conjunctive use program.

- Identify potential recharge areas and develop recharge scenarios.

HYDROGEOLOGY

Provident Irrigation District is in the central part of the Sacramento Valley, which in turn is part of the Great Central Valley, the largest ground water basin in California.

The Sacramento Valley forms an asymmetrical trough, with a steeply dipping western limb and a more gently dipping eastern limb. Older igneous and metamorphic rocks form a basement on which younger marine and alluvial sediments are deposited. Bedrock is at considerable depth along the valley axis but shallower along the margins.

Hydrogeologic Units

Overlying the basement rocks are Upper Jurassic and Cretaceous marine sandstone, shale and conglomerate containing predominantly saline or brackish water.

Overlying the Cretaceous rocks are younger continental deposits. In the northern part of the valley, these are the Tehama and Tuscan Formations. The Tehama consists mostly of semiconsolidated silt, clay and sand with some coarser lenses of sand and gravel. The Tuscan Formation occurs mostly on the east side of the Sacramento River and consists mostly of volcanically derived breccia, conglomerate, tuffaceous sandstone, tuff, and some less consolidated beds of clay, silt, sand, and gravel.

Quaternary deposits consist of stream alluvium, basin deposits, terrace and fan deposits of the Riverbank and Modesto Formations, and the Red Bluff Formation. The geologic units are shown on the Geologic Map, ***Plate 5***.

Quaternary Alluvium

Quaternary alluvium is mostly of fluvial origin, deposited in active stream channels. These deposits are being transported under modern hydrologic conditions and are generally only slightly weathered. The color is light gray to tan. The alluvium generally contains a mixture of grain sizes, typically varying from clay and silt to gravel. The thickness is generally minor, but along the Sacramento River may be up to 50 feet in places.

Quaternary alluvium is generally not considered a water-bearing unit but may be important when the deposits are thick and in close proximity to a stream. This is the case along rivers and streams where the alluvium may act at certain times of the year as a forebay for the more extensive Tehama Formation.

Basin Deposits

These generally consist of silt and clay derived from the same sources as the Quaternary alluvium. The dark gray to black basin deposits are rich and valuable, especially for rice production. Thickness varies but probably is in the range of 10 to 40 feet in the district.

The basin deposits are not considered an important source of water because of their relatively low permeability, close proximity to the surface and limited thickness, although some domestic wells may draw from this zone.

Terrace and Fan Deposits

Terrace deposits and fan deposits are clay, silt, sand and gravel deposited by fluvial processes during the Pleistocene. They reflect the local source areas in color and composition. The terraces typically flank the present-day stream system, but are elevated at various levels based on the age. There are four terrace levels in the district. From youngest to oldest and lowest to highest, these are the upper Modesto Formation, lower Modesto Formation, upper Riverbank Formation, and the lower Riverbank Formation. The terraces normally occur on the floodplain of the Sacramento River and the fan deposits generally occur along the edge of the valley.

Modesto Formation

The Modesto is the youngest and the lowest topographically of the Pleistocene terraces. The upper member is unconsolidated, unweathered gravel, sand, silt, and clay. There are soils to several feet thick with A/C horizon profiles, but unlike the lower member, they lack argillic B horizons. The upper member is generally only five to 10 feet thick, but in some places may be as thick as 30 feet. The age is believed to range between 12,000 and 26,000 years old.

The lower member is an unconsolidated, slightly weathered gravel, sand, silt, and clay deposit that forms terraces five to 10 feet higher than the upper member. Soils developed on the lower member contain an argillic B horizon marked by a noticeable increase in clay content and a distinctive red color. The unit is much more extensive than the upper member. The age is believed to range between 30,000 and 42,000 years.

The hydrogeology of the Modesto Formation is generally not significant because of the localized extent and the shallow depths. However, the unit is considered to be excellent both for natural and artificial recharge areas because of the coarse, permeable nature of the deposit and its proximity to streams.

Riverbank Formation

The Riverbank is distinctly older than the Modesto and can be differentiated by its geomorphic position above the Modesto and the higher degree of soil profile weathering and development. The formation consists of a clay, silt, sand, and gravel with a light reddish color forming flat, clearly recognizable alluvial terraces and fans. The formation displays thicker argillic B horizons with a Munsell 10YR to 5YR hues. The age of the Riverbank is believed to be between 130,000 and 450,000 years old based on stratigraphic clues, weathering, and soil development.

The upper member is dark brown to reddish alluvium composed of gravel, sand, silt and minor clay. It is the lowest topographically of the two members. The upper member is smoother than the lower member.

The lower member is similar in composition but is more reddish in color. It is generally elevated about ten feet higher than the upper member. Its surface is much more dissected than the upper member with up to 10 feet of local relief. The Munsell hue approaches a maximum of 2.5YR.

The Riverbank is generally not considered to be an important source of groundwater, particularly near the center of the valley because of its limited extent and thickness. The formation also contains more clay than the Modesto and is not as permeable. The Riverbank can be a source of water and serve as a recharge area in the alluvial fans along the west side of the Sacramento Valley.

Red Bluff Formation

The Red Bluff Formation is a thin veneer of distinctive, highly weathered bright-red gravel overlying the Tehama and Tuscan Formations. A small outcrop of this formation occurs in the northwest part of the study area. The gravel contains sand, silt, and clay in the matrix. The gravel is typically somewhat cemented or contains cemented layers or hardpan in the surface soils. The Red Bluff is a sediment cover on a pediment surface ranging in age from 450,000 to 1 million years old.

The Red Bluff probably covered most of the valley floor at one time but now only occurs as isolated erosional remnants on the top of hills and ridges. Thickness ranges from a few feet to 10 feet in the study area to 50 feet in the northern part of the valley.

The formation is not considered a water-bearing unit because of its limited extent, thin surficial exposures, and low permeability.

Tehama Formation

The Tehama is a tan to pale green or gray, semiconsolidated sand and silt with lenses of gravel derived from the Coast Ranges and the Klamath Mountains. The formation is fluvial in origin and consists of both stream channel and overbank deposits. It interfingers with the volcanically derived sand, silt, tuff, and tuff-breccia of the Tuscan Formation along the central axis of the valley. The Nomlaki Tuff Member occurs near the stratigraphic base of both the Tehama and the Tuscan. The normal thickness of the Tehama along the Sacramento River is about 2,000 feet but it can range to over 3,000 feet in places. Based on fossil evidence, it ranges in age from Upper Pliocene to Middle Pleistocene.

The Tehama is the major water bearing unit of the Sacramento Valley. The base of the Tehama is also the base of fresh groundwater since the underlying Cretaceous rocks contain salt water. Most of the irrigation and domestic wells draw from this formation. In the study area, the Tehama is intersected typically at a depth of about 10 to 30 feet.

Proportions of sand and gravel vary considerably, resulting in highly variable well yields. The coarse grained sand and gravel lenses produce large volumes of water to wells but vary in thickness, areal extent, and depth from the surface. The lenses may be discontinuous or partially continuous.

In areas with predominantly fine deposits, the permeability and well yields are low. Although there is considerable water in storage, the high clay content reduces the permeability to the point where little water is yielded to wells.

Regional Aquifer Characteristics

A comprehensive discussion of Sacramento Valley groundwater was published in the report *Evaluation of Ground Water Resources: Sacramento Valley* by the Department of Water Resources, Northern District (1978). The following discussion includes some of the conclusions and observations for the study area from this report.

The average depth to groundwater is from zero to 10 feet. The direction of groundwater flow is from the northwest to the southeast (S30E), towards the Sacramento River. The average gradient in that direction is about .0024, or 2.4 feet per 1000 feet. Transmissivity is shown as about 50,000 ft^2/day. The average discharge of 59 wells in an area much larger than but including PID, was 1,690 gal/min from an average well depth of 315 feet.

The base of fresh groundwater is about 1300 feet below the ground surface. The report shows the PID as an area where the average annual groundwater recharge exceeded discharge.

The specific yield will vary considerably based on the parent material. The fine portion of the aquifer may yield from a few percent to 12 percent. The sandy zones yield from 12 to 20 percent and the gravel may yield up to 25 percent. There are a number of sand and gravel zones in the Tehama that underlies the area.

This area has been traditionally an area of low groundwater pumpage because of a plentiful surface water supply. Areas to the north and northwest have historically pumped three to six times more groundwater per acre of land than land within PID.

Specific capacities are identified as being high, or over 75 gal/min/ft.

The approximate average permeability for the top 50 feet is shown as 400 gal/day/ft^2. The weighed average for the top 400 feet is about 490 gal/day/ft^2. Well yields are high, generally exceeding 2,000 gallons per minute.

Natural recharge consists of a general northwest to southeast underflow of groundwater from the Coast Ranges foothills, direct precipitation, and surface water infiltration from streams. Recharge also occurs along the Sacramento River, particularly during the winter, depending on the relative elevations of the Sacramento River and the local unconfined groundwater table. The zone of influence of about one mile is apparent by looking at the results of our monitoring program along Sidds Landing.

Some artificial recharge occurs from the application and percolation of irrigation water. Although local soils have low permeabilities in most places, there are some rice fields on Modesto Formation deposits that take a lot of water.

Land Subsidence

Land subsidence is the lowering of the land surface caused by groundwater, oil, or gas extraction and the subsequent compaction of fine sedimentary deposits. The subsidence may cause damage to structures and water transfer facilities, reduce well yields, and increase flooding in flood-prone areas. Subsidence is a serious problem in the San Joaquin Valley but has not been reported north of Yolo County in the Sacramento Valley. Detailed surveying to identify subsiding areas have not been done north of Sutter and Yolo Counties. There are numerous gas wells in the district and surrounding area that may be causing subsidence or that would affect the subsidence monitoring grid.

GROUNDWATER OCCURRENCE AT THE PROVIDENT IRRIGATION DISTRICT

PID is in the Colusa subbasin of the Sacramento Valley groundwater basin. The major aquifer from which most agricultural wells draw from is the Tehama Formation. Some domestic wells may also draw water from more surficial layers.

Aquifer Characteristics

The only detailed information available about the aquifers underlying PID is from Water Well Completion Reports and from pump tests on PID #4 (State Well Number T20N/R01W30L01) conducted by the Department of Water Resources. DWR conducted two pump tests, one in November 1995 and the second in February 1996.

Plate 6 shows a hydrogeologic cross-section along Sidds Road (Road 44). The plate shows well locations, well construction, and distribution of coarse- and fine-grained deposits. The coarse deposits consisting of sand and gravel is the predominant water bearing unit with sufficient permeability. The predominant coarse grained units occurs at depths ranging from 75 to 125 feet below ground surface. A deeper zone occurs between 275 to 325 feet bgs, but both of these zones appear to be lenticular and discontinuous. Both these zones are considered to be confined or leaky.

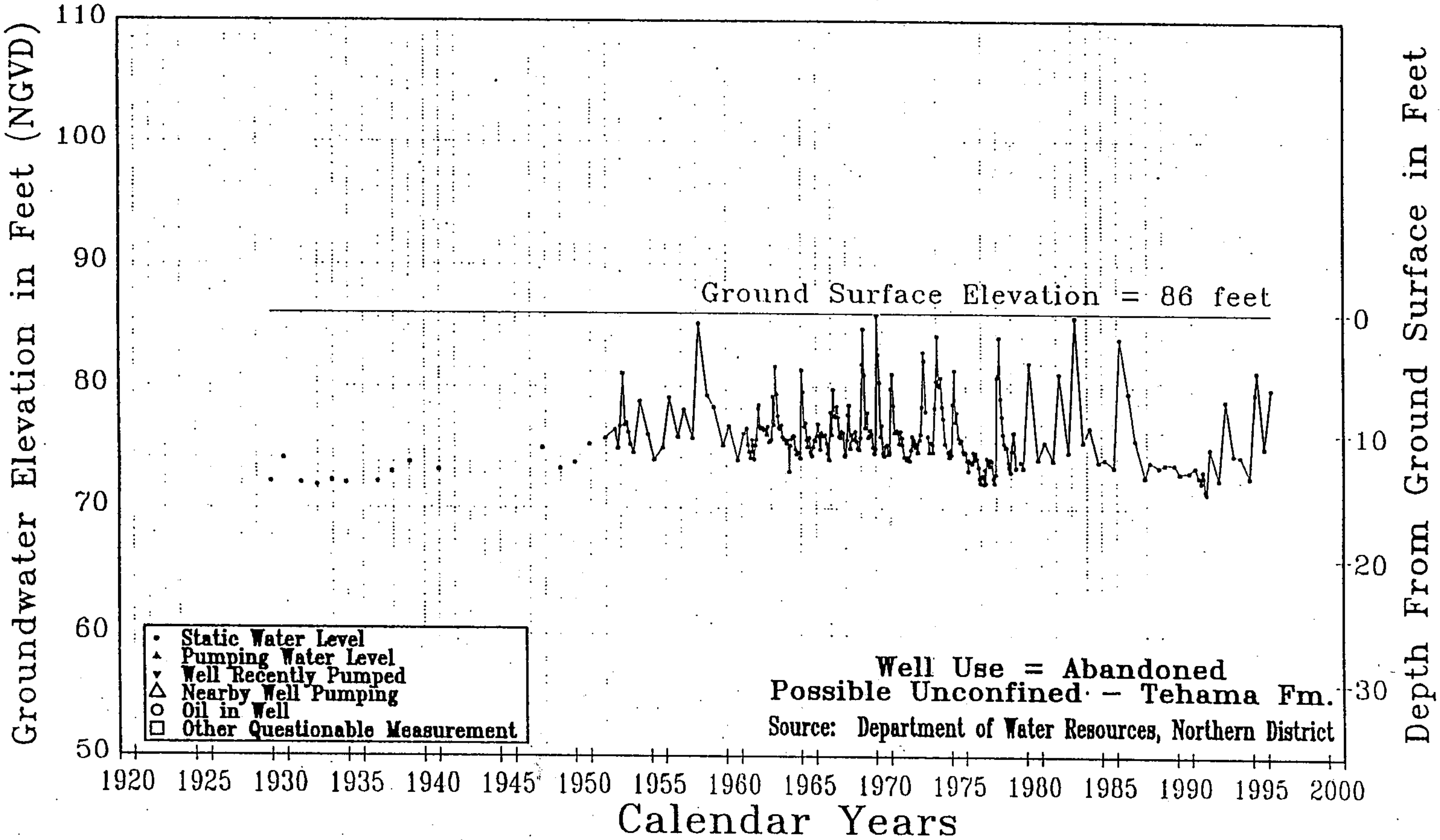
Transmissivity, calculated using numerous aquifer test equations and the computer program AqteSolv from the results of the aquifer test, ranged from about 400,000 to 800,000 gallons per day per foot of width and averaged about 550,000. The two wells farther from the river had higher calculated transmissivities, but because of the distance between them and the pumped well, the amount of uncertainty is high and the results were not included in the average. The pumped well, PID #4, had a transmissivity of about 385,000 gallons per day per foot.

Storativity ranged from a low of about 0.00001 to a high of .004, with an average of .0013.

Department of Water Resources Monitoring Wells

DWR has been monitoring eight wells semiannually in Township 19N, Range 2W and 20N, Ranges 1W and 2W near the Road 44 study area. These are shown in Table B1 in Appendix B and the hydrographs are in Appendix C4. Records for some of these wells begin in the 1930s and some begin in the 1940s, allowing us to look at long-range trends.

Figure 1 shows State Well Number 19N/2W-13J01M which has been monitored since



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WELL HYDROGRAPH FOR 19N/02W-13J01M

PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY

Figure 1

1930. This well has the longest record and appears to be fairly typical of the unconfined aquifer in the area. Water levels in this well are at or near the ground surface during the winter and spring, and average about 10 feet below ground surface during the summer and fall. This well also seems to have been relatively unaffected by California's extended 1986-1992 drought, except that winter levels did not recover as far as normal. The long-range trend is no change in groundwater levels which probably reflects the minimal groundwater use in this area.

Figure 2 shows State Well Number 20N/02W-29G01M which is about two miles west of our aquifer test monitoring grid. The water levels in the well represent a composite of both the unconfined and confined aquifer system. This well also shows minor variation between spring and fall measurements and an average water level that is less than 10 feet below ground surface. This well also shows a slight drought related impact of about two feet.

We conclude that seasonal fluctuations are minimal, typically less than ten feet. Annual changes are also minimal, with groundwater levels in the 1930s similar to the present.

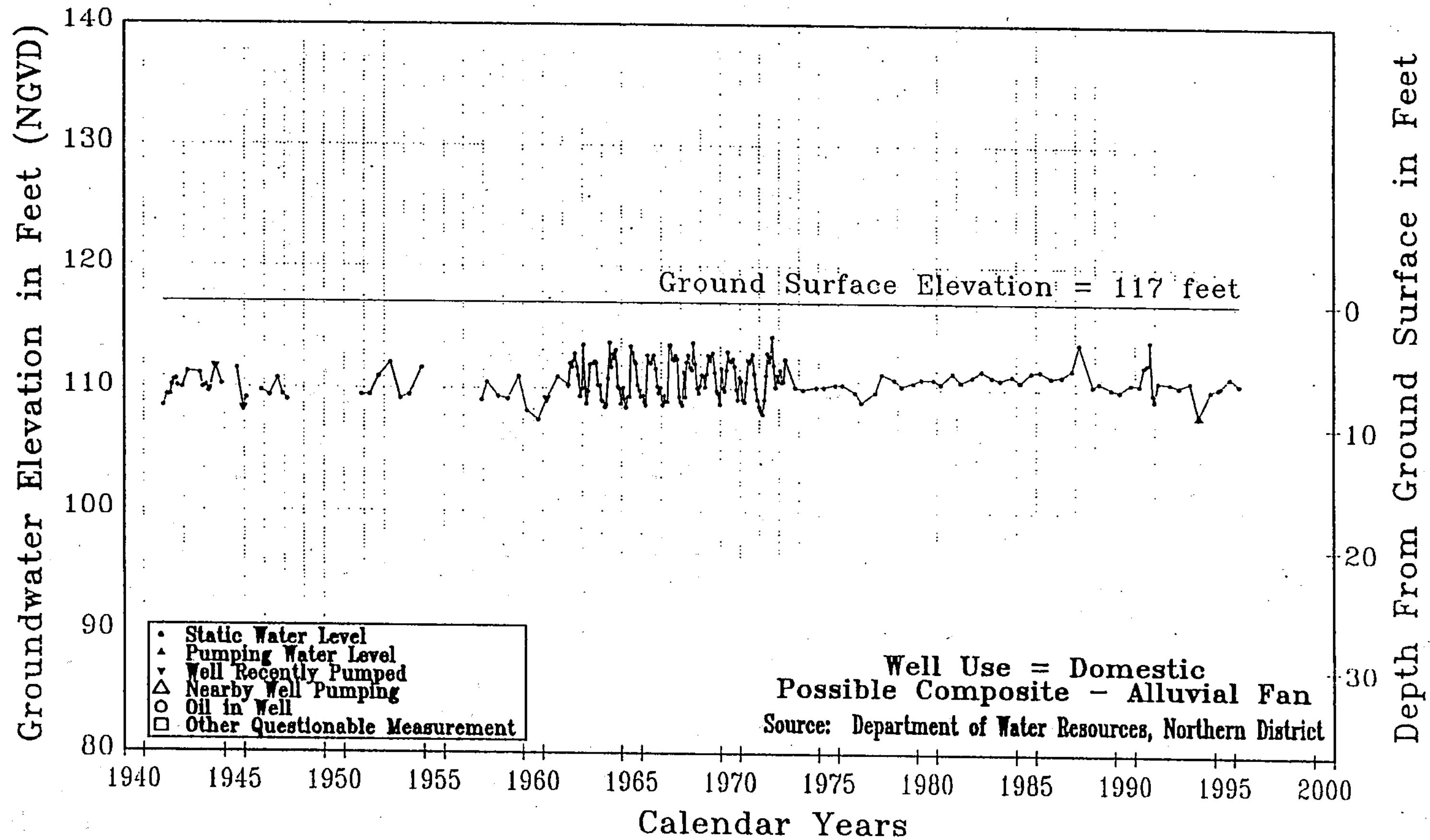
Groundwater movement is illustrated in the composite groundwater elevation maps. Ideally, the analyses would only include wells of similar construction and depth but this is generally not practical because of the few number of wells and those with unknown construction. The direction of movement is down the elevation contour approximately perpendicular to the contours. The elevations were determined by averaging long-term DWR monitoring grid records of spring and fall measurements. The period 1980-1996 was chosen because most of the wells were measured during that time period.

Figure 3 shows the spring water level measurement contours. The contours show that the general groundwater flow is from the NW to the SE and toward the Sacramento River. The gradient is 0.0011 or about 5.9 feet per mile that decreases to about 0.0005 near the Sacramento River.

The fall contours in ***Figure 4*** show the flow to be in the same general direction. The water levels are somewhat lower however. The gradient in the upper part of Provident is about the same as the spring, or about 0.0010. Near the Sacramento River the gradient decreases to about 0.0003 and the groundwater flow direction is nearly parallel to the river. Also apparent is a groundwater depression that develops in the fall to the west of the southern part of PID.

This is also apparent in ***Figure 5*** which shows a composite spring to fall groundwater change map constructed by contouring the difference between the average of spring and fall measurements for the period of record for each well. This 16-foot depression in the fall water table disappears by the spring because of winter recharge.

Figure 2



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WELL HYDROGRAPH FOR 20N/02W-29G01M

PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY

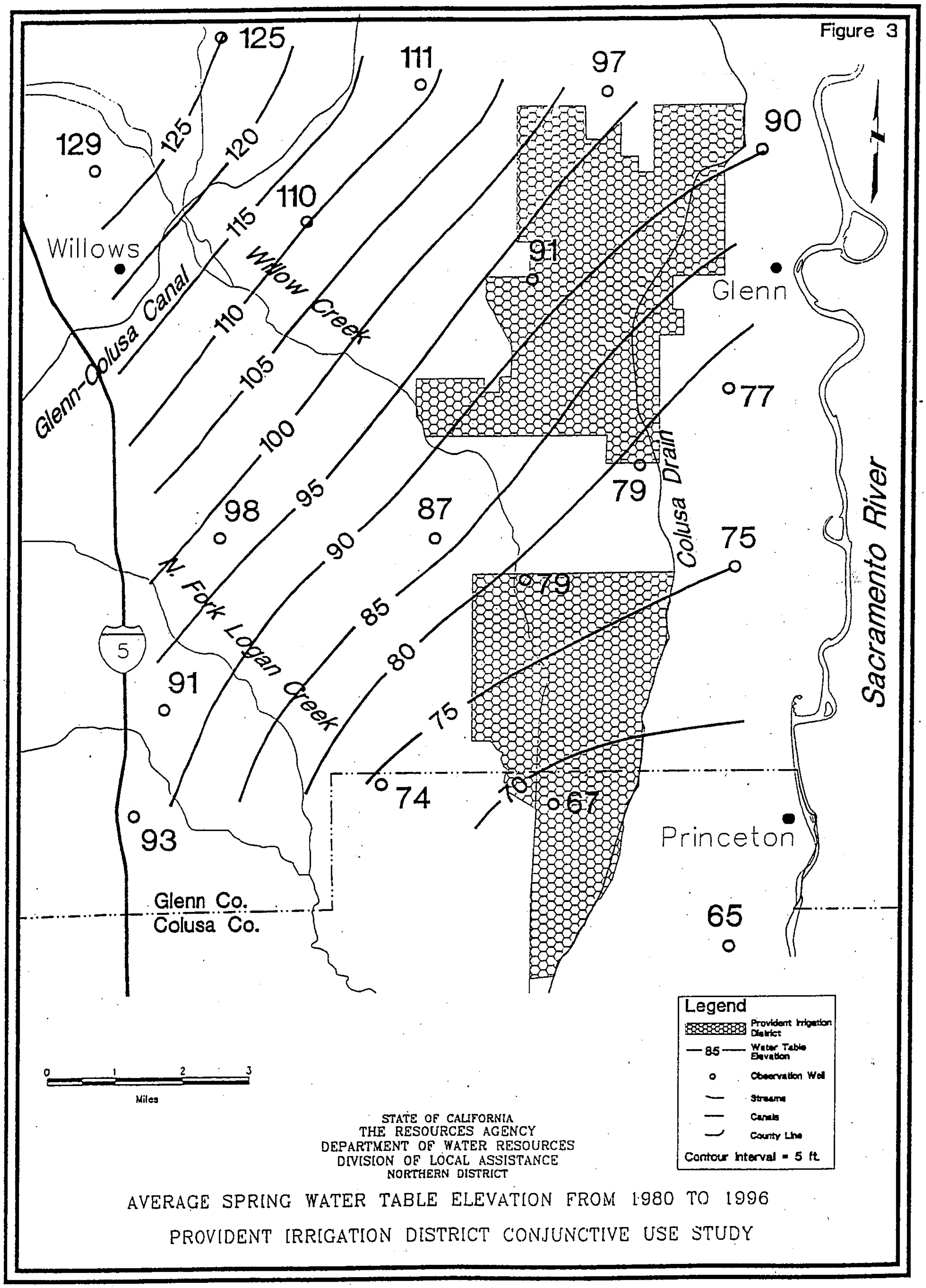
Figure 3
125
111
97
129
90
110
125
120
115
Willows
Glenn-Colusa Canal
Willow Creek
91
Glenn
110
105
100
77
79
Colusa Drain
98
95
87
90
75
N. Fork Logan Creek
85
79
5
80
91
75
74
70
67
93
Princeton
Glenn Co.
Colusa Co.
65
Sacramento River
Legend
Provident Irrigation District
85 Water Table Elevation
Observation Well
Streams
Canals
County Line
Contour Interval = 5 ft.
0 1 2 3
Miles
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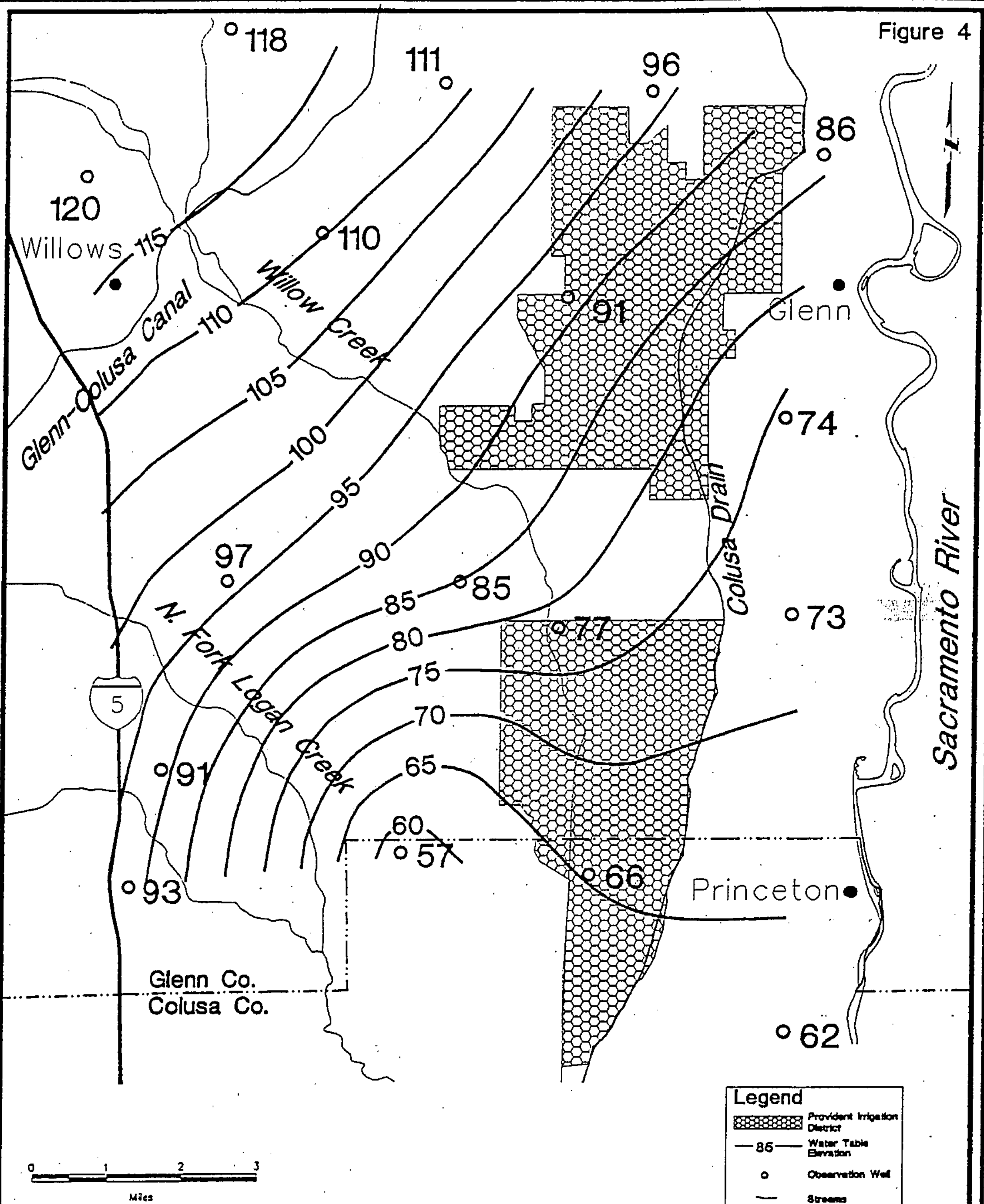
NORTHERN DISTRICT
AVERAGE SPRING WATER TABLE ELEVATION FROM 1980 TO 1996
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY



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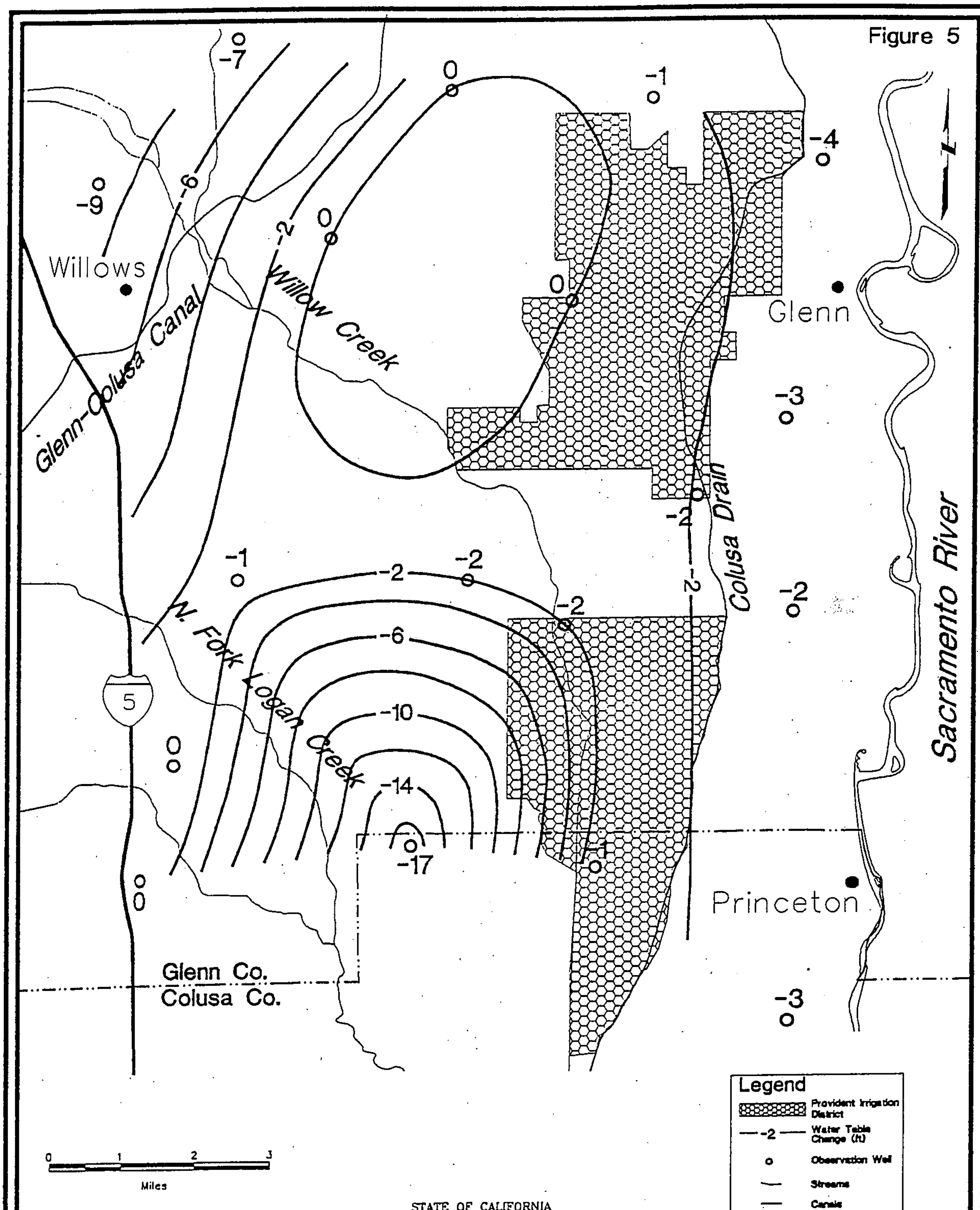
AVERAGE FALL WATER TABLE ELEVATION FROM 1980 TO 1996
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY



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NORTHERN DISTRICT

AVERAGE SPRING TO FALL GROUND WATER LEVEL CHANGE FROM 1980 TO 1996
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY

Project Monitoring Wells

Provident Irrigation District has four agricultural wells that it can use during periods of short surface water supply. In addition, there are a number of domestic and irrigation wells that were used for monitoring groundwater levels. The wells and a short description are shown in ***Table 4***.

The wells were surveyed in using the Trimble surveying system by the Environmental Engineering Section. The horizontal coordinates are provided in UTM Zone 10 and the elevations are in feet above sea level (NGVD 29) using the NAD-27 control coordinates.

Two highly precise geodetic network (HPGN) monuments were used for horizontal and vertical control. Two permanent monuments were established at the endpoints of the project area using static GPS occupation of approximately one hour. Sidds XE is a chiseled X on the north end of the north wing wall at the Sidds Landing Pump house. Sidds XW is a chiseled X on the Northwest corner of a concrete pad in the southeast part of the intersection of Sidds Road and Provident Blvd. (Road V). Three more vertical control monuments were used: ORDS2, FWS348 (FWS #428), and V852.

Each well was located using fast static GPS occupations. The horizontal and vertical coordinates are precise to plus or minus a few centimeters.

TABLE 4
PUMP TEST MONITORING WELLS IN THE PROVIDENT IRRIGATION DISTRICT STUDY AREA

Well #	UTM-Coordinates in meters	Depth of Well in feet	Ground Elevation in feet	Average Depth to Groundwater in feet	Description
20N/01W-29M01	4378904.46 585615.17	*	102.83	17	Domestic - Bertapelle
20N/01W-29M02	4378958.65 585580.58	*	102.58	18	Domestic - Bertapelle
20N/01W-30G01	4379044.02 584962.87	*	104.20	8	Domestic - Correia
20N/01W-30H01	4379021.72 585367.84	*	102.11		Domestic - Weir Ranch
20N/01W-30K02	4378859.14 584747.44	*	101.50		Irrigation - Bertapelle
20N/01W-30K03	4378861.76 584753.43	*	101.32	8	Irrigation - Bar Jay Dee Inc.
20N/01W-30L01	4378949.47 584411.81	*	100.79		Irrigation - Provident Irrigation District
20N/02W-25J02	4378946.72 583671.32	*	96.87	13	Irrigation - Provident Irrigation District
20N/02W-25J03	4378938.72 584013.12	*	102.6	13	Irrigation - Provident Irrigation District
20N/02W-25L01	4378901.25 582833.04	*	99.95	1	Irrigation - Southam
20N/02W-27J02	4378893.81 580780.71	*	102.88		Irrigation - Garcia

* Depth of well is confidential information and is not published in this report

AQUIFER TEST RESULTS

The Department of Water Resources performed a short preliminary aquifer test on November 11, 1995 and a longer test beginning on February 1, 1996 at the Provident Irrigation District PID#4 well. The purpose of the preliminary test was to evaluate water level response in preparation for the more extensive test. The pumped well is about 4,000 feet from Sidds Landing and the river.

Preliminary Aquifer Test

The preliminary test included 219 minutes of measurements while pumping at an average rate of 599.2 cubic feet per minute (4,480 gpm), and 103 minutes of recovery measurements with the pump turned off. Illustrations showing the results of the test are in ***Appendix C1*** and include aquifer test data for the pumping well and 9 monitoring wells, and some preliminary analyses of aquifer characteristics.

Results from this preliminary analysis showed that:

- Water level measurements from the pumping well could be inaccurate. The static level was 13.5 feet BGL but went to 45 feet one minute after the pump was started, where it stayed for the remainder of the pump test. It is also possible that this is the true pumping level, suggesting that the cone of depression intersected a major source of recharge water, such as the Sacramento River. It was recommended that better access to PID#4 be developed by PID to allow more confidence in well measurements during pumping. This was done shortly after completion of the test.

- There is a sand and gravel zone of the Tehama Formation from which the wells draw that is also intersected by the river thalweg. It is possible that the sandy zone provides direct interconnectivity between the pumping well and the Sacramento River. The well is about 4,000 feet from the Sacramento River.

- Wells 30K3 and 30G1 are completed only in the upper coarse-grained deposit and had drawdowns during the test. Therefore, monitoring wells proposed to monitor this zone will add little to the testing program and need not be constructed.

- Aquifer transmissivity is high, in the order of 400,000 to 450,000 gallons per day per foot, or higher, as calculated by using the Cooper-Jacob, Theis, and Hantush methods.

- The calculated coefficient of storage (0.0017-0.0020) indicates a confined or leaky confined aquifer.

We concluded at the end of the preliminary aquifer test that:

- Better measurement access to PID#4 needs to be provided and this was promptly done.
- Interconnectivity between the pumped aquifer at PID #4 and the Sacramento River cannot be ruled out at this time.
- We should continue plans for a more extensive aquifer test to determine the interconnectivity.
- The small drawdowns seen in wells 30K3 and 30G1, completed in the upper coarse-grained deposit, indicate that there is separation between the lower coarse-grained material and the 100-foot sand.
- A one day aquifer test performed on well 30K2 would be advantageous in determining the aquifer characteristics of the upper coarse-grained deposit.

Main Aquifer Test

A more extensive aquifer test was begun on February 1, 1996 that lasted to February 5, with monitoring to February 10. The test consisted of a constant discharge - time drawdown aquifer test of PID #4 surrounded by 11 observation wells. Five observation wells lie within 2.3 miles west and six lie within 0.76 miles to the east. A 100 - hour constant discharge rate of 4,466 gpm was maintained.

PID placed a measuring tape access tube to PID#4 so that accurate drawdown measurements could be taken. ***Appendix C2*** contains all the water level measurements made during the test.

The first two days of the test, the Sacramento River stayed at a constant flow, but on February 3, the river began to rise in response to heavy rains. Water levels in the wells near the river except for the pumping well showed a rapid response to the rising river elevations.

Figure 6 shows the time versus drawdown for the pumping well PID#4. The total amount of drawdown for the 100 - hour test was 32.8 feet. Plotted on a semi-log graph, the main part of the graph plots on a nearly straight line.

The observation well nearest PID #4 (30L01) is well 30K02 at a distance of about 1,140 feet. Drawdown at this well was observed one minute after the test began at 0.05 feet. The water level continued to decrease reaching a maximum drawdown of 3.40 feet. The farthest observation well from PID#4 is 27J02 at a distance of 11,914 feet to the west. A drawdown of 0.10 feet was observed at 80 minutes into the test and reached a maximum of 0.60 at 3,043 minutes.

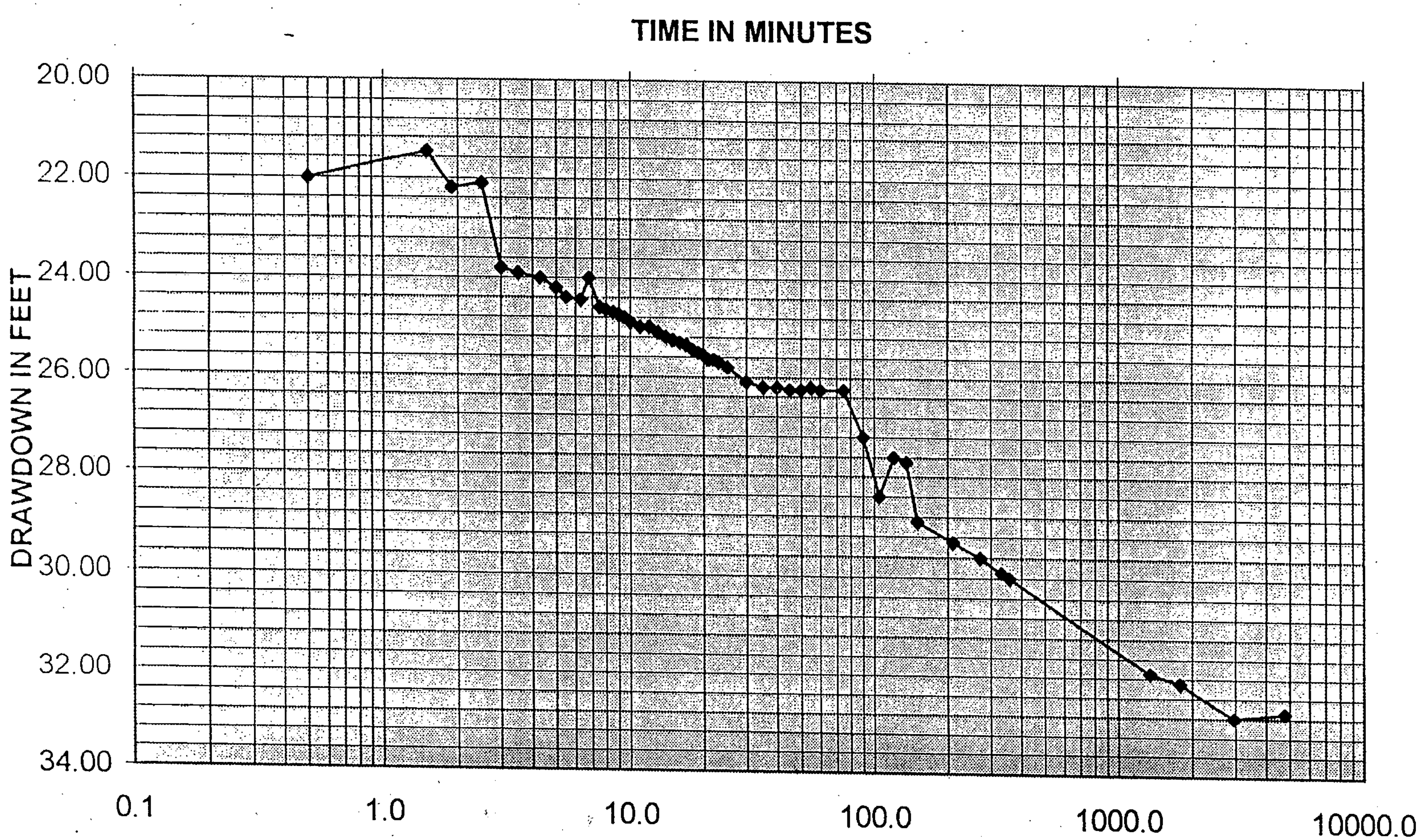
The data from the pumping and monitoring wells were entered into the computer program AqteSolv to calculate various aquifer characteristics. Both confined and semi-confined solutions were calculated. The graphs are shown in ***Appendix C2***. ***Table 5*** shows the results using the Theis, Cooper-Jacob, Hantush-leaky and Moench-leaky solutions.

The transmissivity of PID#4 using the Theis equation was 35.8 ft^2 per minute or about 386,000 gallons per day per foot.

TABLE 5

	PROVIDENT IRRIGATION DISTRICT AQUIFER TEST DATA							
WELL#	THEIS		COOPER-JACOB		HANTUSH-LEAKY		MOENCH-LEAKY	
	transmissivity(ft^2/min)	storativity	transmissivity(ft^2/min)	storativity	transmissivity(ft^2/min)	storativity	transmissivity(ft^2/min)	storativity
20N01W30K02M	73.65	0.003603	124.6	0.001258	108.5	0.002849	68.96	0.004362
20N01W30L01M	35.8	6.14E-06	35.8	6.14E-06	41.83	4.70E-07	16.65	7.67E-05
20N01W30K03M	68.28	0.003684	81.56	0.002379	71.25	0.0035	68.09	0.003657
20N02W25J30M	39.3	0.000367	43.13	0.000267	38.34	0.000376	37.53	0.000382
20N02W25J03M	38.53	0.000376	43.03	0.000268	39.69	0.000366	38.6	0.000377
20N01W30G01M	65.19	0.001986	70.88	0.001589	67.64	0.001926	65.87	0.001964
20N02W25J02M	49.39	0.000817	58.82	0.000517	51.62	0.00079	54.01	0.000659

Note: Pumping well is shown in *italics*. The values derived using the Theis equation is considered to be the most representative of the actual aquifer values. Note that 1 ft^2/minute is equivalent to 10,771.2 gallons per day per foot.



CONSTANT DISCHARGE AQUIFER PERFORMANCE TEST
PUMPING WELL 30LO1M ON 2-1-96
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY

MONITORING PROGRAM

The Northern District began to monitor and plot groundwater elevations in November 1995 in preparation for the first aquifer test. Monitoring data is in ***Appendix C3*** and the groundwater levels are plotted in ***Figure 7.*** This figure shows groundwater elevations for 11 monitoring wells and the elevation of the Sacramento River water surface. One observation is that water levels in all the wells with the exception of two have a strong correlation with changes in the water surface elevation of the Sacramento River. Also evident in this figure is the time period when PID#4 was pumping during the February aquifer test and drawdown in several of the wells during spring pumping.

Figure 7. Graph of groundwater elevation changes in monitoring wells at Provident Irrigation District and the water surface elevation of the Sacramento River.

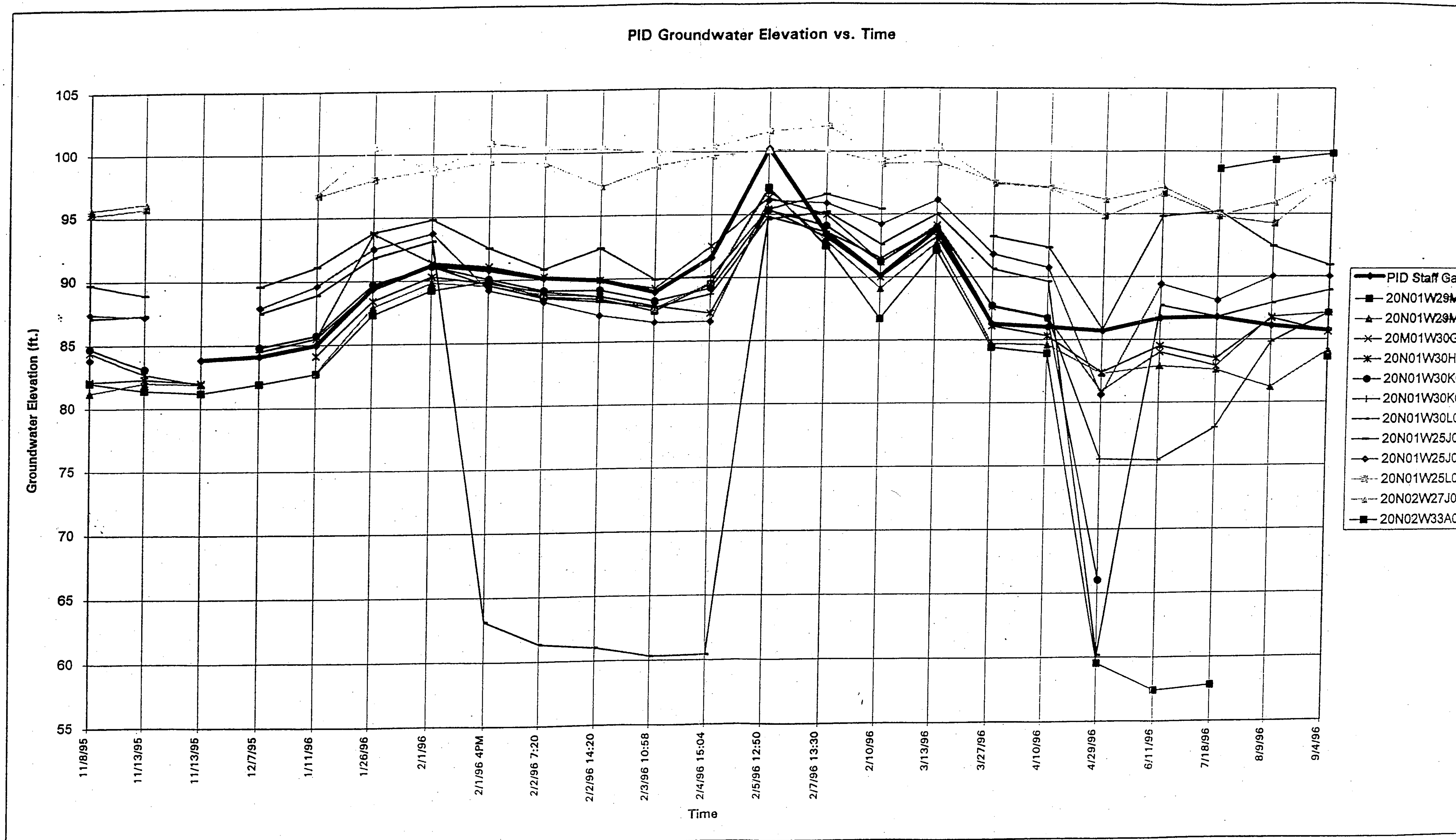
Figures 8 to 13 is a sampling of 20-plus plots of groundwater elevations that were measured during the study. A composite plot of all the measured water levels is shown on ***Plate 7***, in the back pocket. The Sacramento River water surface elevation at the Princeton-Codora Irrigation District pumps, a few hundred yards below the PID pumps, is also shown.

Figure 8 plots groundwater elevations on November 8, 1995 during the late fall. Elevations to the west away from the river are high and within 10 feet of the ground surface. However, next to the river, the groundwater table is lower, coincident with the low river water level at that time of the year.

Figure 9 shows the elevations on February 1, 1996 during the late winter, and the day before our main aquifer test. Water levels to the west are within a few feet of the surface. Water levels next to the river are also high, about the same level as the Sacramento River.

Figure 10 displays the elevations on February 4, 1996 near the end of the test. Note the 36 feet of drawdown and the effect on surrounding wells. Note also that water levels increased at 25L01 and 27J02, probably as a result of heavy rains, and that 30H01 had been recently pumped, resulting in a local depression. River levels had just begun to rise at the time of the measurement.

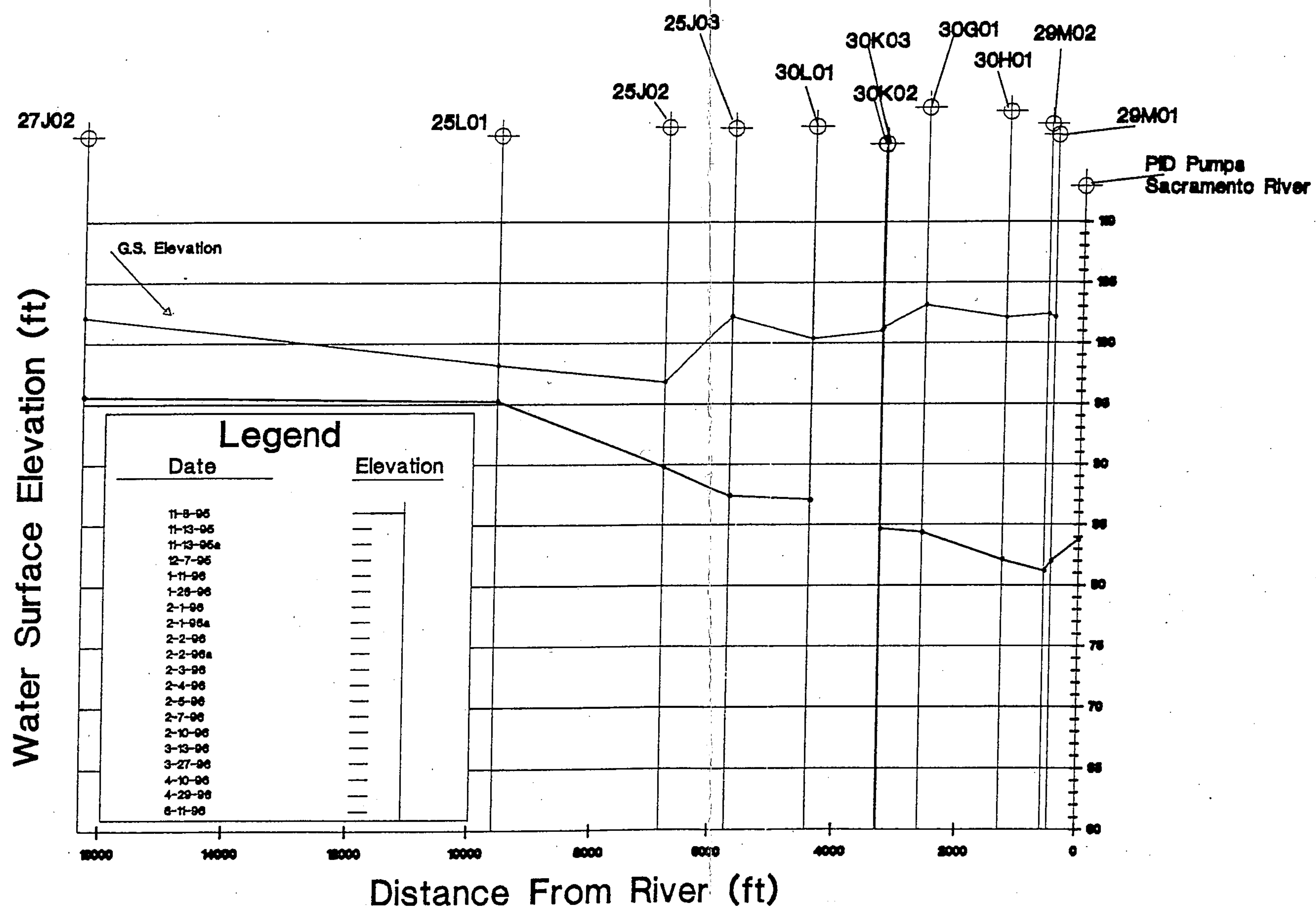
Figure 11 shows the elevations on February 5, the day after PID#4 was shut down. Note also that the river stage increased remarkably during the period and that the pumping well and surrounding monitoring wells not only fully recovered from the pumping but also exceeded pre-test levels. This is an indication of the high aquifer



PID Groundwater Elevation vs. Time
Groundwater Elevation (ft.)
105
100
95
90
85
80
75
70
65
60
55
11/8/95
11/13/95
11/13/95
12/7/95
1/11/96
1/26/96
2/1/96
2/1/96 4PM
2/2/96 7:20
2/2/96 14:20
2/3/96 10:58
2/4/96 15:04
2/5/96 12:50
2/7/96 13:30
2/10/96
3/13/96
3/27/96
4/10/96
4/29/96
6/11/96
7/18/96
8/9/96
9/4/96
Time
PID Staff Gag
20N01W29M
20N01W29M
20M01W30G
20N01W30H
20N01W30K
20N01W30K
20N01W30L
20N01W25J
20N01W25J
20N01W25L
20N02W27J
20N02W33A

PIC

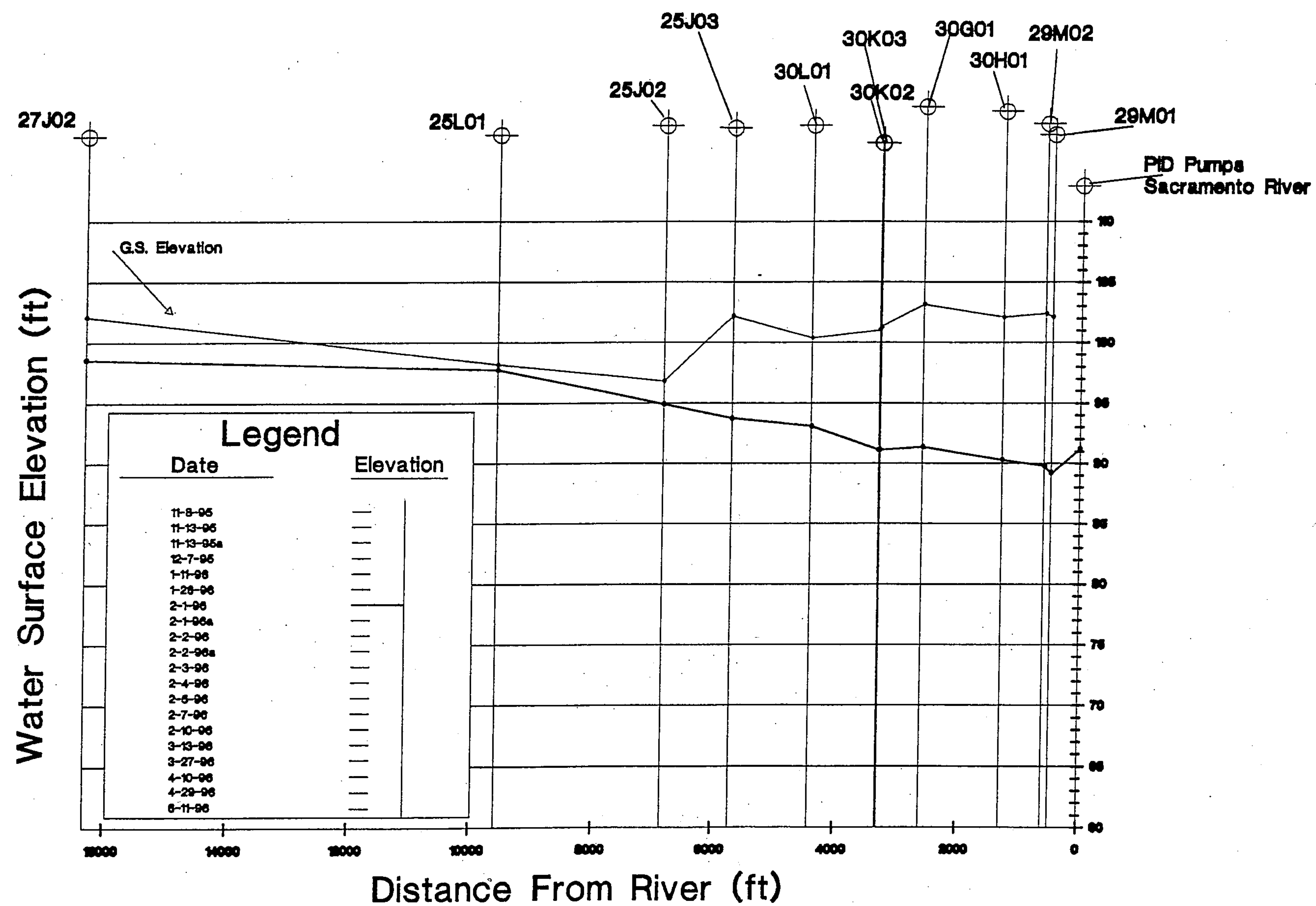
Figure 8



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF LOCAL ASSISTANCE
NORTHERN DISTRICT

GROUNDWATER LEVEL CROSS-SECTION FOR 11-8-95
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY

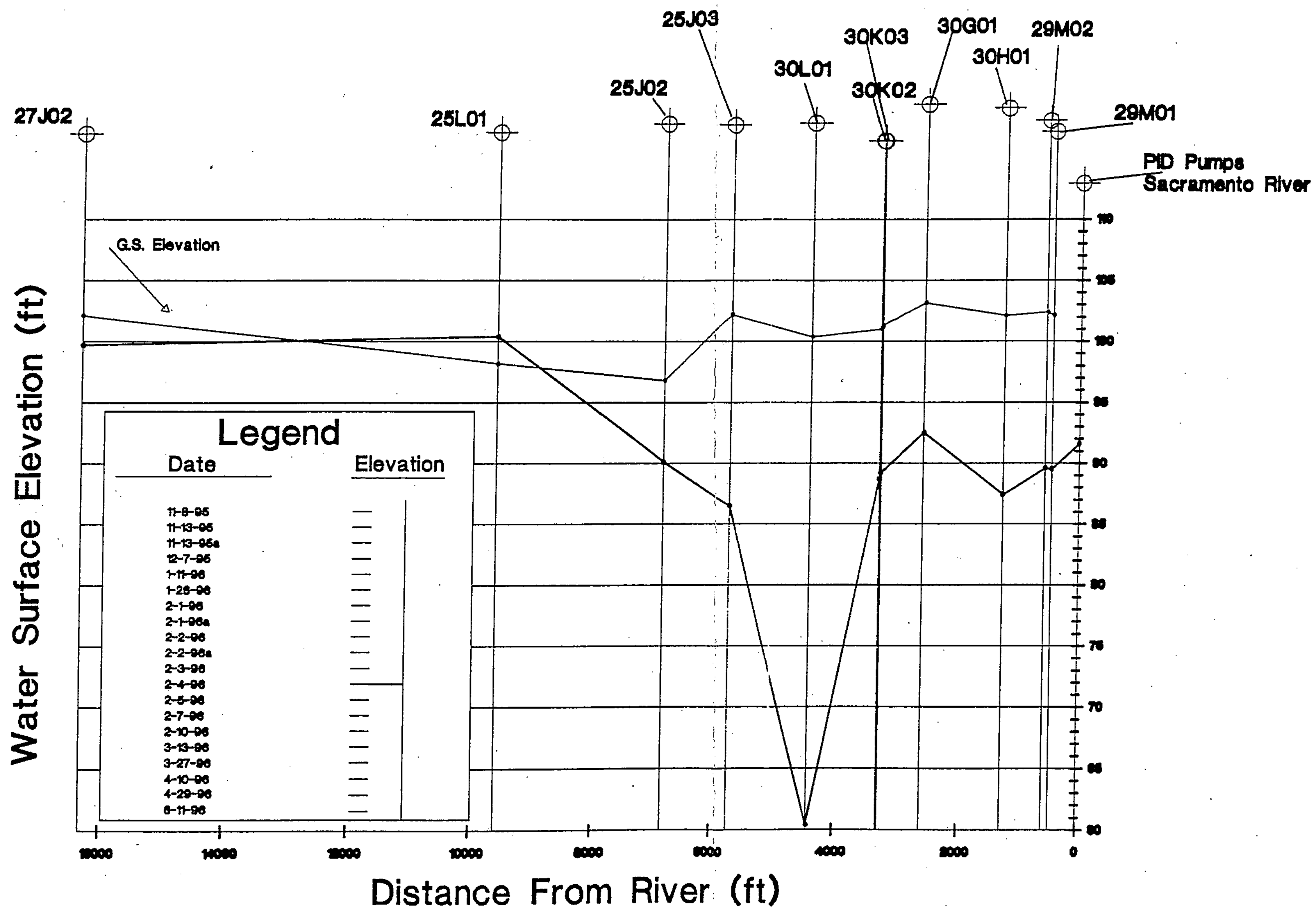
Figure 9



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF LOCAL ASSISTANCE
NORTHERN DISTRICT

GROUNDWATER LEVEL CROSS-SECTION FOR 2-1-96
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY

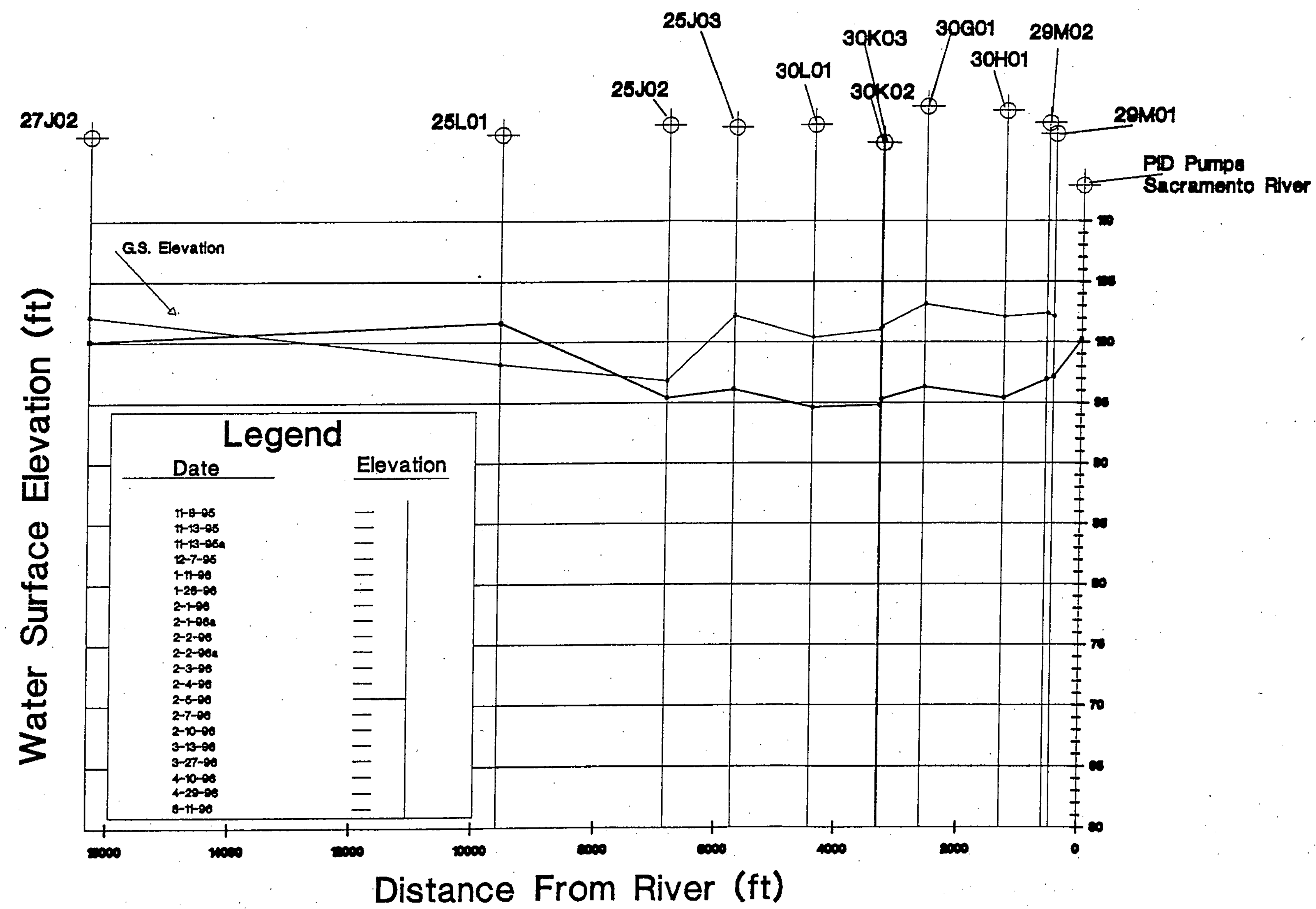
Figure 10



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF LOCAL ASSISTANCE
NORTHERN DISTRICT

GROUNDWATER LEVEL CROSS-SECTION FOR 2-4-96
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY

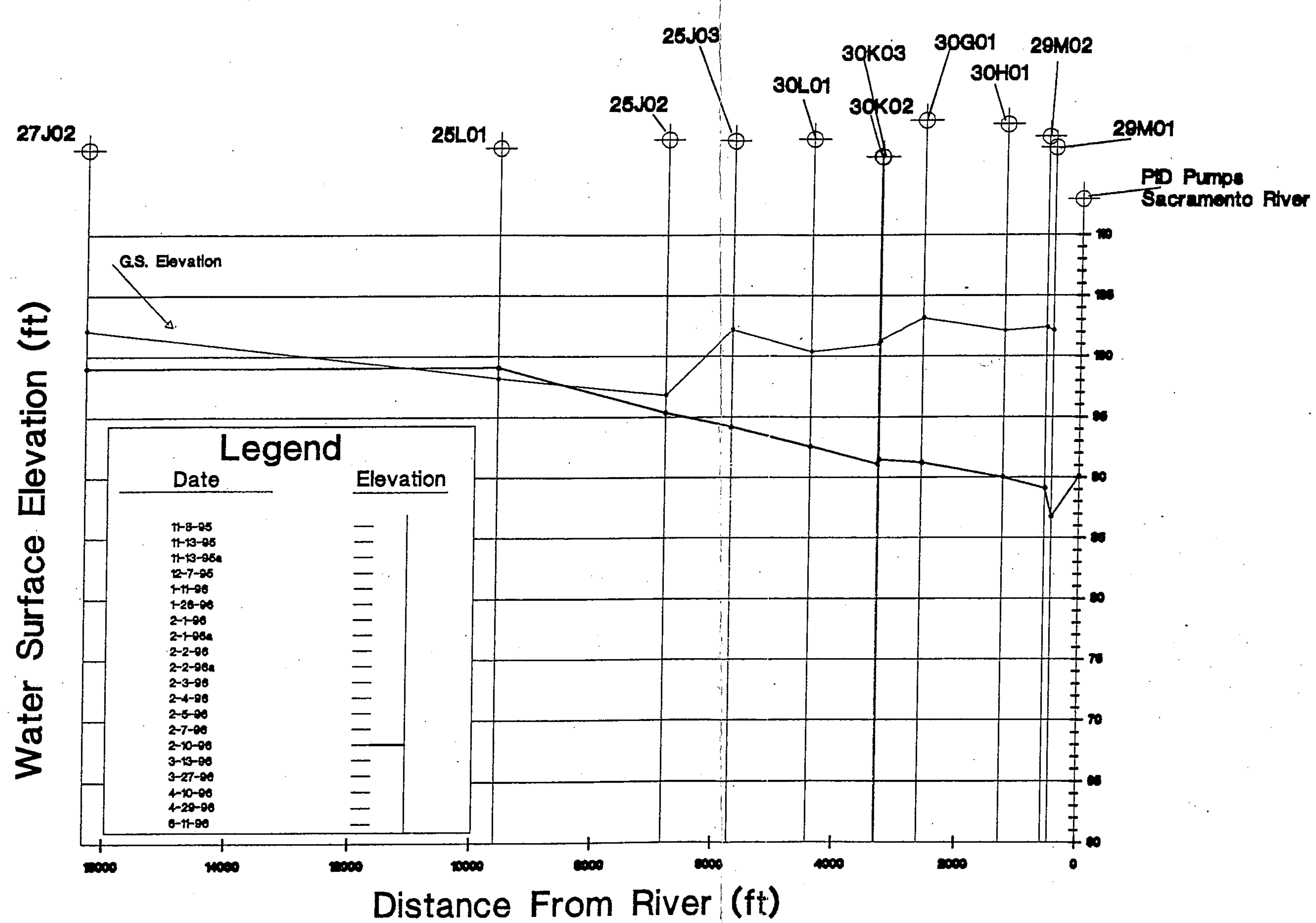
Figure 11



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF LOCAL ASSISTANCE
NORTHERN DISTRICT

GROUNDWATER LEVEL CROSS-SECTION FOR 2-5-96
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY

Figure 12



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF LOCAL ASSISTANCE
NORTHERN DISTRICT

GROUNDWATER LEVEL CROSS-SECTION FOR 2-10-96
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY

transmissivities and suggests an intertie with Sacramento River water elevations. The local groundwater gradient also changed direction to away from the river.

Well 25L01 and 27J02 water levels also went up, probably in response to rain. These wells appear to be out of the direct influence of the Sacramento River.

Figure 12 plots the elevations on February 10. By this time the river stage dropped 10 feet and the groundwater table appears to have dropped in response to the river.

Figure 13 displays the elevations on April 29. At this time, several pumps (29M01,30K02, 30L01) in the area have been turned on, resulting in drawdown about 25 feet below the water surface elevation of the Sacramento River. The Sacramento River is low, but because of groundwater pumping, the gradient is locally away from the river. Water is probably being drawn from the west side along the regional gradient, and from the river to the east.

This figure probably represents the local groundwater gradients during spring and summer pumping. It is clear that there is an intertie between the Sacramento River and wells drawing from the 100-foot sand and gravel lens near the river. What is not clear is the amount of water that is derived from this zone and the amount of water derived from the deeper aquifers.

There are a number of observations that can be made by reviewing the aquifer test and monitoring data. It is not clear whether these same conclusions apply to other areas near the Sacramento River. These observations are:

- There seems to be a general correspondence between the groundwater elevation in unpumped wells closer than one mile to the Sacramento River and the water surface elevation of the river. Wells farther away do not seem to be influenced as readily or not at all.

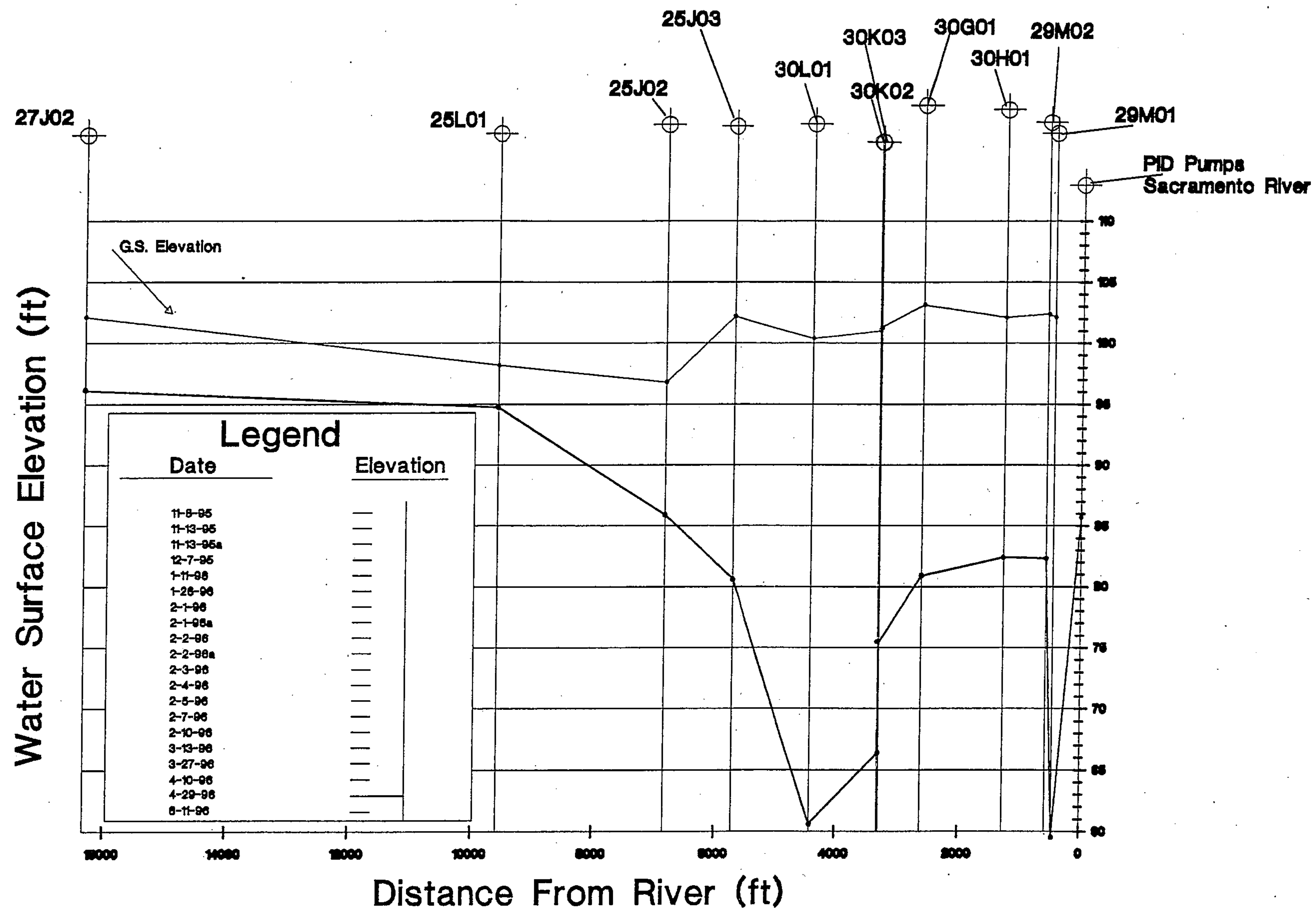
- The Sacramento River is a gaining stream and the groundwater table appears to be sloping toward the Sacramento River during most of the year, except in localized areas during periods of pumping. During high flows in the winter, when the Sacramento River water surface elevation is higher than the local water table, the river is a losing stream and the river contributes to the local groundwater table.

- Groundwater pumping during the spring and summer depresses the groundwater table in places adjacent to the river causing a local groundwater gradient change away from the Sacramento River. This would result in the Sacramento River contributing to the local groundwater table.

- There is a rapid response of less than a day to changes in river water surface elevation by the groundwater table in wells close to the river. It is assumed that this rapid response is caused by highly permeable deposits that occur near the Sacramento River, including alluvial deposits and sand and gravel lenses in the Tehama Formation.

- The depth of the river was nearly 50 feet in places, as shown on ***Plate 6***, measured during summer flows using a depth finder. This allows for a strong possibility that the river intersects the first coarse layer found at about 100 feet below ground surface.

Figure 13



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF LOCAL ASSISTANCE
NORTHERN DISTRICT

GROUNDWATER LEVEL CROSS-SECTION FOR 4-29-96
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY

GROUNDWATER QUALITY

Groundwater chemistry is affected by both the rock types in the surrounding drainages and by the nature of the aquifer materials. The relationship may be quite complex an not well known. Factors that influence groundwater quality include mineral composition of the primary rock types, minor soluble rock types such as salt and gypsum, connate water from marine deposits, pollution, and infiltration from sources of poor quality water. In the basin, redeposition of dissolved constituents, ion exchange reactions, and surface pollution are important considerations.

The groundwater at PID is a calcium-magnesium or magnesium-calcium bicarbonate type. Total dissolved solids are in the average around 200 to 500 mg\l but may range as high as 1,500 mg\l in isolated wells (Borcalli and Associates, 1995). The base of fresh water is at about 1,400 feet below ground surface (CDWR,1978).

Water quality parameters pH and electrical conductivity were measured at the pumping well PID#4 and the Sacramento River during the pump test described previously. pH values varied from 8.2 to 8.0 with an apparent decrease with time. During the same time, Sacramento River pH values decreased from 7.9 to 7.6 as shown in ***Figure 14***.

Figure 15 shows that the electrical conductivity in the well increased during the pumping, beginning with an EC of about 320 micromhos and then leveling off at about 420. The reason for the increase could be that during the pumping more water is being drawn from lower aquifers having more dissolved solids. The Sacramento River averaged an EC of about 160 for most of the pump test, then dropped to about 90 near the end of the test in response to increased flows caused by heavy rains.

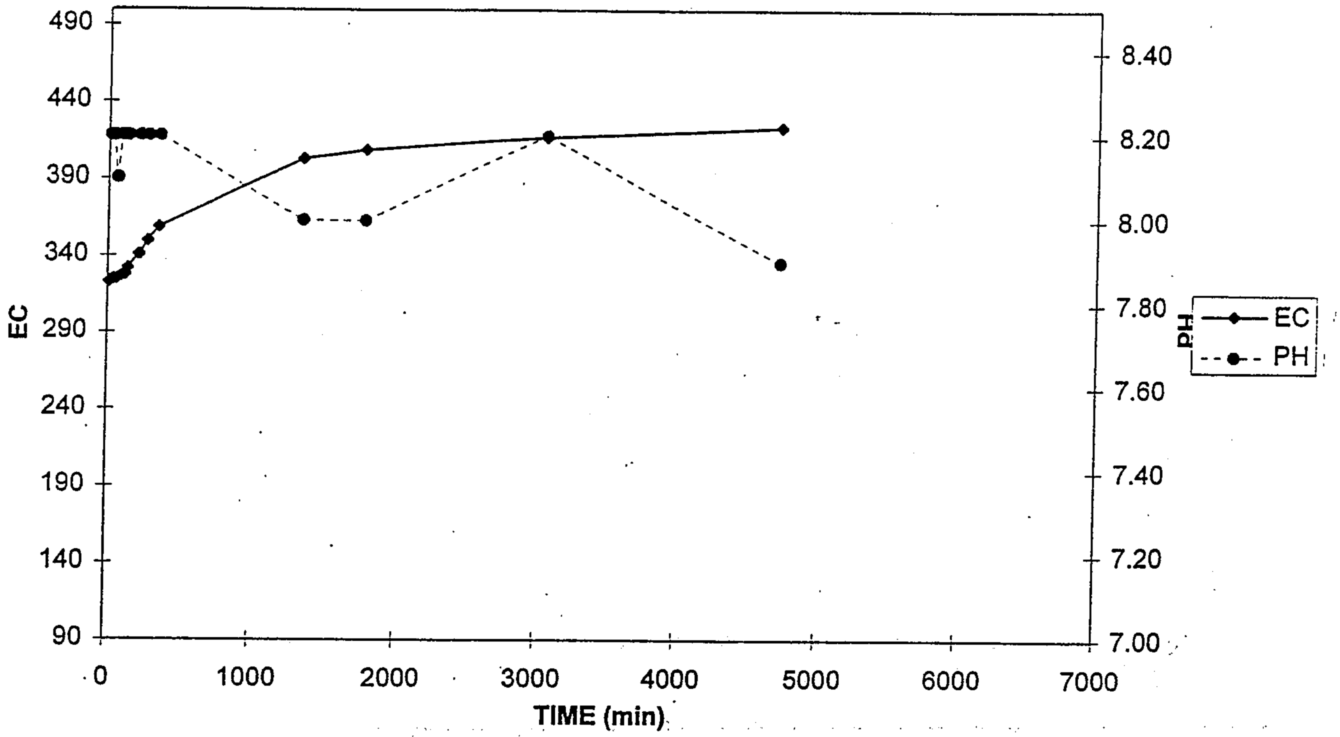


Figure 14. Graph Showing changes in electrical conductivity and pH in the pumping well.

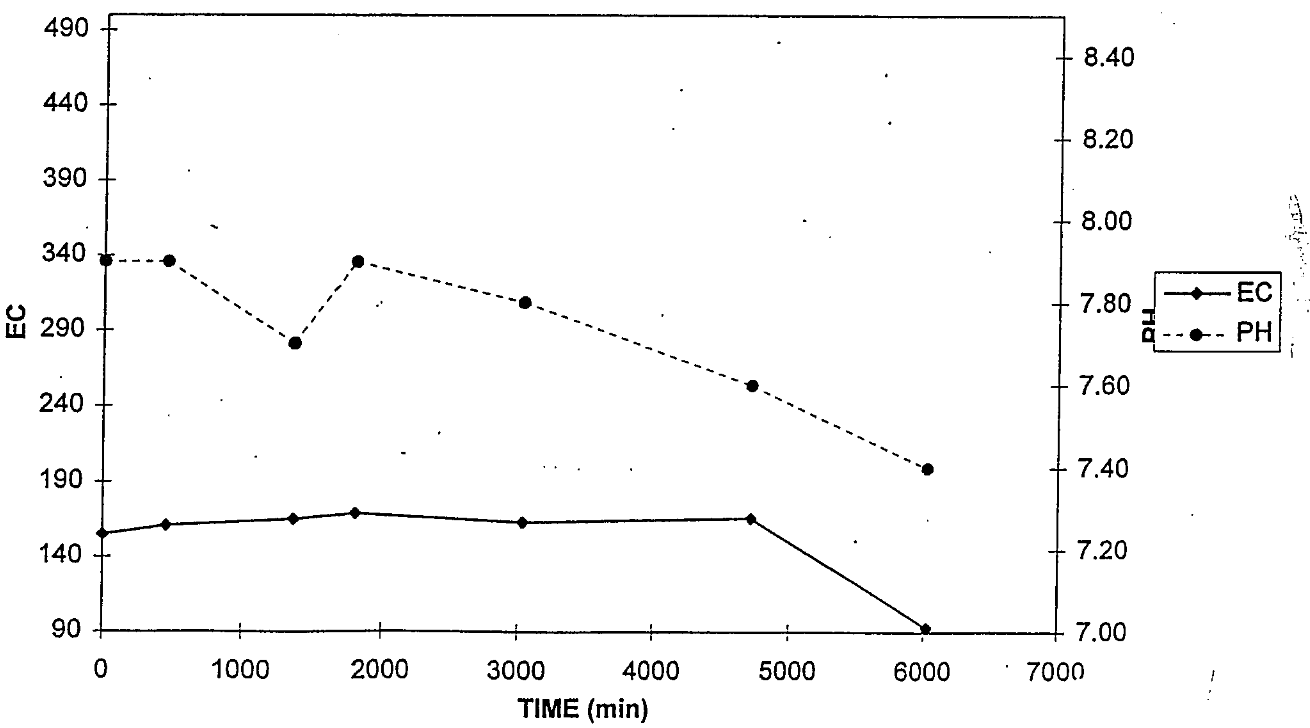


Figure 15. Graph showing electrical conductivity and pH in the Sacramento River.

REFERENCES

Association of California Water Agencies. 1993. *Elements of a Ground Water Management Plan.* Draft AB3030 Ground Water Management Manual.

Borcalli and Associates. 1995. *Princeton-Codora-Glenn Irrigation District and Provident Irrigation District Groundwater Management Plan.* Review Draft.

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APPENDIX A
STATE WELL NUMBERING SYSTEM

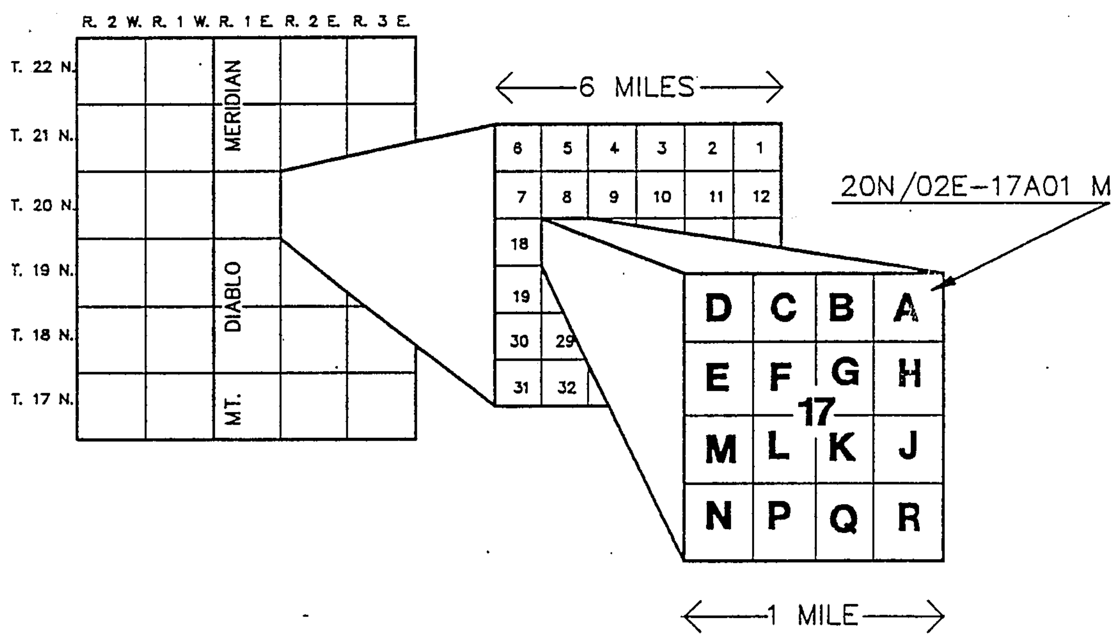
STATE WELL NUMBERING SYSTEM

Each well in the monitoring program is assigned an official ***State Well Number***. The Department has sole responsibility for assigning State Well Numbers to water wells in California, and each number uniquely identifies a well based on its location.

Each State Well Number includes a township, range, and section number. Each section is further subdivided into sixteen 40 acre tracts, which are assigned a letter designation as shown below. Within each 40 acre tract, wells are numbered sequentially in order inventoried. The final letter signifies the baseline and meridian. The example below is for State Well Number 20N/02E-17A01M.

For the sake of brevity, only the last part of a well number may be used to refer to a well after the full number has been introduced. For example, well 20/N02E-17A01M may be referred to as 17A01.

State Well Numbering System



The lettering system does not contain the letters "I" and "O".

PROVIDENT IRRIGATION DISTRICT STATE WELL NUMBERS AND GENERAL INFORMATION FOR GROUNDWATER WELLS WITHIN THE MONITORING GRID						
	State Well Number	Owners Well #	Coordinates		RP Elevation	GS Elevation
			UTM - X	UTM - Y		
1	20N01W29M01M		585615	4378904	102.8	102.1
2	20N01W29M02M		585581	4378959	102.6	102.4
3	20M01W30G01M		584963	4379044	104.2	103.1
4	20N01W30H01M		585368	4379022	102.1	102.1
5	20N01W30K02M		584747	4378859	101.5	101
6	20N01W30K03M		584753	4378862	101.3	101.3
7	20N01W30L01M	PID #4	584412	4378949	100.8	100.4
8	20N01W25J02M	PID #2	583671	4378947	96.9	96.8
9	20N01W25J03M	PID #3	584013	4378939	102.6	102.2
10	20N01W25L01M		582833	4378901	100.8	97.8
11	20N02W27J02M		580774	4378900	102.9	102.1
12	19N02W09A01M		579219	4374852	132.4	131.8
13	19N02W13J01M		583711	4372514	86.6	86
14	19N02W23Q01M		581882	4370398	89	87
15	19N02W23Q02M		581712	4370383	87	86
16	20N01W31E01M		584475	4377830	96.4	96
17	20N02W13G01M		582833	4382639	113.4	113
18	20N02W27J01M		580850	4379162	103.2	102
19	20N02W29G01M		576820	4379438	118.2	117
NOTE: GS = Ground Surface, RP = Reference Point, UTM = Universal Transverse Mercator						

APPENDIX B
WELL QUALIFICATION DATA

WELL QUALIFICATION DATA

Well qualification is a standardized process to identify the aquifer(s) associated with individual monitoring wells (***Table B1***).A groundwater basin is normally stratified with several layers of pervious, impervious and semipervious material. These layers form an upper unconfined and one or more lower semiconfined and confined zones or aquifers. Water wells may draw from two or more aquifers.

Wells are ***qualified*** by identifying the aquifers and its properties. Water levels from qualified wells may then be compared to determine groundwater contours, gradients, yearly changes and other data.

The four components of well qualification are:

- The ***groundwater body*** classification of the aquifer including:
  1. Unconfined
  2. Semiconfined
  3. Confined
  4. Previously named zone either confined or unconfined, such as the "A zone".
  5. Composite, consisting of both unconfined and confined zones.

- The ***degree of certainty*** associated with the groundwater body classification.
  1. Definite: Evidence is conclusive.
  2. Probable: Evidence is not conclusive, but fairly convincing.
  3. Possible: Evidence is not conclusive, but fairly likely.

- The ***hydrogeologic unit*** as the water bearing material associated with the groundwater body such as Tehama, floodplain deposits, or alluvial fan.

- The ***date and registration number*** of the licensed professional qualifying the well.

Information used to qualify a well may be found from the following sources.

- Well Completion Reports contain the lithology and depths penetrated, well construction information, and well test data such as drawdown and yield. When no Well Completion Report is available, a report from a nearby well is used and the degree of certainty reduced to probable or possible.

- Geologic maps and stratigraphic columns.

- Water level records that can be analyzed for trends and fluctuations, pump test records, water quality, and temperature.

- Electric logs that chart the resistivity versus depth and can be used to locate the boundaries of water bearing material.

The amount of information available for a well affects the groundwater body classification degree of certainty.

TABLE B1

	PROVIDENT IRRIGATION DISTRICT WELL QUALIFICATION DATA					
	State Well Number	Owners Well #	Water Body	Confidence	Hydrologeologic Unit	Well Use
12	*19N02W09A01M*		unconfined	definite	flood basin alluvium	observation
13	*19N02W13J01M*		unconfined	possible	Tehama	abandoned
14	*19N02W23Q01M*		confined	possible	Tehama	destroyed 11-51
15	*19N02W23Q02M*		confined	probable	Tehama	dom
1	20N01W29M01M		confined	probable	Tehama	irr
2	20N01W29M02M		confined	possible	Tehama	dom
3	20M01W30G01M		confined	possible	Tehama	dom
4	20N01W30H01M		confined	possible	Tehama	dom
5	20N01W30K02M		confined	probable	Tehama	irr
6	20N01W30K03M		confined	probable	Tehama	irr
7	20N01W30L01M	PID #4	confined	probable	Tehama	irr
8	20N01W25J02M	PID #2	confined	probable	Tehama	irr
9	20N01W25J03M	PID #3	confined	probable	Tehama	irr
10	20N01W25L01M		confined	probable	Tehama	dom
11	20N02W27J02M		confined	probable	Tehama	irr
16	*20N01W31E01M*		confined	probable	Tehama	dom
17	*20N02W13G01M*		composite	possible	Tehama	dom
18	*20N02W27J01M*		confined	possible	Tehama	irr
19	*20N02W29G01M*		composite	possible	alluvial fan	dom
	NOTE: All wells were qualified by Koll Büer (RG#3677) on 07-12-96.					

Note: State Well Numbers shown in *Italics* are measured semi-annually.

APPENDIX C
WATER LEVEL MEASUREMENT DATA

C1: Preliminary Aquifer Test Data
C2: Main Aquifer Test Data
C3 Monitoring Data
C4: Historic Glenn County Groundwater Level Measurements in PID area

APPENDIX C I
PRELIMINARY AQUIFER TEST DATA

AQUIFER TEST DATA

OWNER: P.I.D. #2 ADDRESS: ROAD 44 COUNTY GLENN STATE: CA
DATE: 11/13/95 ORGANIZATION PERFORMING TEST DWR MEASURED BY: KYB
WELL NO.: 20N02W25J02M DISTANCE FROM PUMPING WELL 0.5 MI. W TEST TYP PUMPING AND RECOVERY
MEASURING EQUIPMENT: STEEL TAPE TEST I.D. 1

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	11	13	95	9	58	t	STATIC LEVEL	7.9 FT. @ 0915 HRS.	HOW Q MEASURED	
PUMP OFF	11	13	95	13	43	t'	R.P. LOCATION	HOLE IN W.SIDE P.B.	DEPTH OF PUMP/AIR LINE	
							R.P. ELEV:	0.1 FT. ABOVE G.S.	PREVIOUS PUMPING?	
TEST DURATION	3 HOURS 41 MINUTES								DURATION/END	

DATE MO	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE Q AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
11	13	95			65.0			8.50	0.60				
11	13	95			94.0			8.80	0.90				
11	13	95			115.0			8.90	1.00				
11	13	95			149.0			9.20	1.30				
11	13	95			180.0			9.40	1.50				
11	13	95			205.0			9.60	1.70				
													PUMP OFF.
11	13	95			261.0	36.0		9.65	1.75				
11	13	95			290.0	65.0		9.30	1.40				
11	13	95			293.0	68.0		9.30	1.40				

AQUIFER TEST DATA

OWNER: P.I.D. #3 ADDRESS: ROAD 44 COUNTY GLENN STATE: CA
DATE: 11/13/95 ORGANIZATION PERFORMING TEST DWR MEASURED BY: KYB
WELL NO.: 20N02W25J03M DISTANCE FROM PUMPING WELL 0.25 MI W TEST TYP PUMPING AND RECOVERY
MEASURING EQUIPMENT: STEEL TAPE TEST I.D. 1

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	11	13	95	9	58	t	STATIC LEVEL	15.0 @ 0920 HRS.	HOW Q MEASURED	
PUMP OFF	11	13	95	13	43	t'	R.P. LOCATION	HOLE IN P.B.	DEPTH OF PUMP/AIR LINE	
TEST DURATION	3 HOURS 41 MINUTES						R.P. ELEV:	0.4 FT. ABOVE G.S.	PREVIOUS PUMPING?	
									DURATION/END	

DATE MO	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE Q AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
11	13	95			0.0			15.20	0.20				
11	13	95			5.0			15.80	0.80				
11	13	95			9.2			16.00	1.00				
11	13	95			13.0			16.50	1.50				
11	13	95			19.0			16.70	1.70				
11	13	95			20.0			16.80	1.80				
11	13	95			22.0			16.90	1.90				
11	13	95			24.0			17.00	2.00				
11	13	95			26.0			17.10	2.10				
11	13	95			28.0			17.20	2.20				
11	13	95			30.0			17.20	2.20				
11	13	95			34.0			17.40	2.40				
11	13	95			37.0			17.50	2.50				
11	13	95			40.0			17.50	2.50				
11	13	95			42.0			17.60	2.60				
11	13	95			50.0			17.75	2.75				
11	13	95			60.0			18.00	3.00				
11	13	95			73.0			18.20	3.20				
11	13	95			80.0			18.30	3.30				
11	13	95			90.0			18.50	3.50				
11	13	95			105.0			18.65	3.65				
11	13	95			144.0			19.10	4.10				
11	13	95			170.0			19.30	4.30				
11	13	95			191.0			19.40	4.40				
11	13	95			201.0			19.45	4.45				
11	13	95			219.0			19.60	4.60				
11	13	95			221.0								PUMP OFF.
11	13	95			226.0	1		19.50	4.50				
11	13	95			227.0	2		19.40	4.40				
11	13	95			228.0	3		19.40	4.40				
11	13	95			229.0	4		19.30	4.30				
11	13	95			230.0	5		19.20	4.20				
11	13	95			231.0	6		19.15	4.15				
11	13	95			232.0	7		19.05	4.05				
11	13	95			233.0	8		19.00	4.00				
11	13	95			234.0	9		18.95	3.95				
11	13	95			235.0	10		18.90	3.90				
11	13	95			237.0	12		18.80	3.80				
11	13	95			239.0	14		18.65	3.65				
11	13	95			241.0	16		18.55	3.55				
11	13	95			243.0	18		18.50	3.50				
11	13	95			246.0	21		18.35	3.35				
11	13	95			251.0	26		18.25	3.25				
11	13	95			264.0	39		17.90	2.90				
11	13	95			271.0	46		17.65	2.65				
11	13	95			281.0	56		17.50	2.50				
11	13	95			291.0	66		17.30	2.30				
11	13	95			301.0	76		17.20	2.20				
11	13	95			324.0	99		17.00	2.00				

AQUIFER TEST DATA

OWNER: P.I.D. #3 ADDRESS: ROAD 44 COUNTY: GLENN STATE: CA
DATE: 11/13/95 ORGANIZATION PERFORMING TES DWR MEASURED BY: KYB
WELL NO.: 20N02W25J03M DISTANCE FROM PUMPING WELL 0.25 MI WE TEST TYP PUMPING AND RECOVERY
MEASURING EQUIPMENT: STEEL TAPE TEST I.D. 1

TIME DATA	DATE MO DY YR	TIME HR MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	11 13 95	9 58	t	STATIC LEVEL	15.0 @ 0920 HRS.	HOW Q MEASURED	
PUMP OF	11 13 95	13 43	t'	R.P. LOCATION	HOLE IN P.B.	DEPTH OF PUMP/AIR LINE	
TEST DURATION	3 HOURS 41 MINUTES			R.P. ELEV:	0.4 FT. ABOVE G.S.	PREVIOUS PUMPING?	
						DURATION/END	

DATE M	DY	YR	CLOCK TIME HRMIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
11	13	95		233.0	8		19.00	4.00				
11	13	95		234.0	9		18.95	3.95				
11	13	95		235.0	10		18.90	3.90				
11	13	95		237.0	12		18.80	3.80				
11	13	95		239.0	14		18.65	3.65				
11	13	95		241.0	16		18.55	3.55				
11	13	95		243.0	18		18.50	3.50				
11	13	95		246.0	21		18.35	3.35				
11	13	95		251.0	26		18.25	3.25				
11	13	95		264.0	39		17.90	2.90				
11	13	95		271.0	46		17.65	2.65				
11	13	95		281.0	56		17.50	2.50				
11	13	95		291.0	66		17.30	2.30				
11	13	95		301.0	76		17.20	2.20				
11	13	95		324.0	99		17.00	2.00				

AQUIFER TEST DATA

OWNER: SOUTHAM ADDRESS: ROAD 44 AT ROAD WW COUNTY GLENN STATE: CA
DATE: 11/13/95 ORGANIZATION PERFORMING TEST DWR MEASURED BY: KYB
WELL NO.: 20N02W25L01M DISTANCE FROM PUMPING WELL 1 MI. WEST TEST TYP PUMPING AND RECOVERY
MEASURING EQUIPMENT: STEEL TAPE TEST I.D. 1

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	11	13	95	9	58	t	STATIC LEVEL	4.3 FT @ 0910 HRS.	HOW Q MEASURED	
PUMP OFF	11	13	95	13	43	t'	R.P. LOCATION	V-NOTCH E.SIDE CSG	DEPTH OF PUMP/AIR LINE	
TEST DURATION	3 HOURS 41 MINUTES						R.P. ELEV:	1.8 FT ABOVE G.S.	PREVIOUS PUMPING?	
									DURATION/END	

DATE MO	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x 001	Q GPM	ELEC METER READING KW	COMMENTS
11	13	95			99.0			4.40	0.10				
11	13	95			121.0			4.40	0.10				
11	13	95			156.0			4.50	0.20				
11	13	95			184.0			4.40	0.10				
11	13	95			210.0			4.50	0.20				
11	13	95			282.0	57.0		4.55	0.25				
11	13	95			285.0	60.0		4.55	0.25				

AQUIFER TEST DATA

OWNER: GARCIA ADDRESS: ROAD 44 COUNTY GLENN STATE: CA
DATE: 11/13/95 ORGANIZATION PERFORMING TES DWR MEASURED BY: KYB
WELL NO.: 20N02W27J02M DISTANCE FROM PUMPING WELL 2.25 MI. WE TEST TYP PUMPING ONLY
MEASURING EQUIPMENT: SOLINST SOUNDER TEST I.D. 1

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	11	13	95	9	58	t	STATIC LEVEL	6.0 FT @ 0900 HRS.	HOW Q MEASURED	
PUMP OFF	11	13	95	13	43	t'	R.P. LOCATION	DISCHG. PIPE SW SIC	DEPTH OF PUMP/AIR LINE	
TEST DURATION				4	HOURS		R.P. ELEV:	0.8 FT ABOVE G.S.	PREVIOUS PUMPING?	
									DURATION/END	

DATE MO	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
11	13	95			160.0			6.80	0.80				

AQUIFER TEST DATA

OWNER:	BERTEPELLE	ADDRESS:	ROAD 44 NEAR HIGHWAY 45	COUNTY GLENN	STATE: CA
DATE:	11/13/95	ORGANIZATION PERFORMING TEST:	DWR		MEASURED BY: SCI
WELL NO.:	20N01W29M01M	DISTANCE FROM PUMPING WELL	1MI. EAST	TEST TYP PUMPING AND RECOVERY.	
MEASURING EQUIPMENT:	STEEL TAPE			TEST I.D.	1

TIME DATA								WATER LEVEL DATA		DISCHARGE DATA	
	DATE			TIME							
	MO	DY	YR	HR	MIN			STATIC LEVEL	20.7 FT. @ 0847 HRS.	HOW Q MEASURED	
PUMP ON	11	13	95	9	58	t		R.P. LOCATION	SOUNDING TUBE SE SIDI	DEPTH OF PUMP/AIR LINE	
PUMP OFF	11	13	95	13	43	t'		R.P. ELEV:	0.7 FT. ABOVE G.S.	PREVIOUS PUMPING?	
TEST DURATION				3 HOURS 41 MINUTES						DURATION/END	

DATE MO	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
11	13	95			139.0			20.90	20.90				
11	13	95			201.0			20.90	20.90				
11	13	95	14	36	278.0	53.0		20.80	20.80				

AQUIFER TEST DATA

OWNER: SOUZA ADDRESS: 8171 ROAD 44 COUNTY GLENN STATE: CA
DATE: 11/13/95 ORGANIZATION PERFORMING TEST DWR MEASURED BY: SCI
WELL NO.: 20N01W29M02M DISTANCE FROM PUMPING WELL 1 MI. EAST TEST TYP PUMPING AND RECOVERY
MEASURING EQUIPMENT: STEEL TAPE TEST I.D. 1

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	11	13	95	9	58	t	STATIC LEVEL	20.4 FT. @ 0853 HRS.	HOW Q MEASURED	
PUMP OFF	11	13	95	13	43	t'	R.P. LOCATION	T.O.C.	DEPTH OF PUMP/AIR LINE	
TEST DURATION	3 HOURS 41 MINUTES						R.P. ELEV:	0.2 FT. ABOVE G.S.	PREVIOUS PUMPING?	
									DURATION/END	

DATE MO	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
11	13	95			146.0			20.50	0.10				
11	13	95			205.0			20.50	0.10				
11	13	95			282.0	57.0		20.50	0.10				

AQUIFER TEST DATA

OWNER: CORREIA | ADDRESS: 8151 ROAD 44 | COUNTY GLENN | STATE: CA

DATE: 11/13/95 | ORGANIZATION PERFORMING TEST: DWR | MEASURED BY: SCI

WELL NO.: 20N01W30G01M | DISTANCE FROM PUMPING WELL 0.3 MI EAS | TEST TYP RECOVERY ONLY

MEASURING EQUIPMENT: STEEL TAPE | TEST I.D. 1

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
							STATIC LEVE	20.4 FT @ 0905	HOW Q MEASURED	
PUMP ON	11	13	95	9	58	t	R.P. LOCATIC	TOC	DEPTH OF PUMP/AIR LINE	
PUMP OFF	11	13	95	13	43	t'	R.P. ELEV:	1.1 FT ABOVE G.S.	PREVIOUS PUMPING?	
TEST DURATION	3 HOURS 41 MINUTES								DURATION/END	

DATE MO	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
11	13	95			1825.0			22.40	2.00				
11	13	95			#########	5.0		22.40	2.00				
11	13	95			#########	10.0		22.40	2.00				PUMPED 30 SEC. @ 1350 HRS.
11	13	95			#########	15.0		22.30	1.90				
11	13	95			#########	20.0		22.20	1.80				
11	13	95			#########	25.0		22.20	1.80				
11	13	95			#########	30.0		22.10	1.70				
11	13	95			#########	40.0		22.10	1.70				
													OWNER HAD WELL 1800 FT. NE PUMPING 3000 G.P.M. SINCE 11/11/95 @ 1000 HRS.

AQUIFER TEST DATA

OWNER: R. G. WEIR RANCH ADDRESS: 8176 ROAD 44 COUNTY GLENN STATE: CA
DATE: 11/13/95 ORGANIZATION PERFORMING TEST: DWR MEASURED BY: SCI
WELL NO.: 20N01W30H01M DISTANCE FROM PUMPING WELL 0.8 MI EAS TEST TYP PUMPING AND RECOVERY
MEASURING EQUIPMENT: STEEL TAPE TEST I.D. 1

TIME DATA							WATER LEVEL DATA		DISCHARGE DATA	
	DATE			TIME						
	MO	DY	YR	HR	MIN		STATIC LEVEL	19.8 FT. @ 0900 HRS.	HOW Q MEASURED	
PUMP ON	11	13	95	9	58	t	R.P. LOCATION	9/16 " HOLE T.O.C.	DEPTH OF PUMP/AIR LINE	
PUMP OFF	11	13	95	13	43	t'	R.P. ELEV:	AT G.S.	PREVIOUS PUMPING?	
TEST DURATION				3 HOURS 41 MINUTES					DURATION/END	

DATE MO	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
11	13	95			158.0			20.10	0.30				GROUND DAMP-FIRE
11	13	95			209.0			20.10	0.30				HOSE COILED HEARBY
11	13	95			272.0	47.0		20.10	0.30				

AQUIFER TEST DATA

OWNER: BERTEPELLE ADDRESS: ROAD 44 NEAR ROAD XX COUNTY: GLENN STATE: CA
DATE: 11/13/95 ORGANIZATION PERFORMING TEST: DWR MEASURED BY: GSP
WELL NO.: 20N01W30K02M DISTANCE FROM PUMPING WELL 0.5 MI SE TEST TYPE PUMPING AND RECOVERY
MEASURING EQUIPMENT: STEEL TAPE AND SOLINST SOUNDER TEST I.D. 1

	TIME DATA						WATER LEVEL DATA		DISCHARGE DATA	
	DATE			TIME						
	MO	DY	YR	HR	MIN		STATIC LEVEL	17.9 FT. @ 0918 HRS.	HOW Q MEASURED	
PUMP ON	11	13	95	9	58	t	R.P. LOCATION	HOLE IN CASING	DEPTH OF PUMP/AIR LINE	
PUMP OFF	11	13	95	13	43	t'	R.P. ELEV:	0.5 FT. ABOVE G.S.	PREVIOUS PUMPING?	
TEST DURATION	3 HOURS 41 MINUTES								DURATION/END	

DATE MO	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
11	13	95			4.8			20.30	2.40				QUESTIONABLE MSMT.
11	13	95			8.3			20.30	2.40				QUESTIONABLE MSMT.
11	13	95			9.6			20.30	2.40				QUESTIONABLE MSMT.
11	13	95			20.0			18.50	0.60				QUESTIONABLE MSMT.
11	13	95			29.0			18.70	0.80				QUESTIONABLE MSMT.
11	13	95			36.0			18.70	0.80				QUESTIONABLE MSMT.
11	13	95			47.0			18.80	0.90				QUESTIONABLE MSMT.
11	13	95			65.0			19.00	1.10				USING SOUNDER.
11	13	95			77.0			19.00	1.10				
11	13	95			93.0			19.10	1.20				
11	13	95			114.0			19.20	1.30				
11	13	95			143.0			19.30	1.40				
11	13	95			176.0			19.40	1.50				
11	13	95			206.0			19.50	1.60				

AQUIFER TEST DATA

OWNER:	BAR JAY DEE INC	ADDRESS:	ROAD 44 NEAR ROAD XX	COUNTY: GLENN	STATE: CA
DATE:	11/13/95	ORGANIZATION PERFORMING TEST:	DWR	MEASURED BY:	GSP
WELL NO.:	20N01W30K03M	DISTANCE FROM PUMPING WELL	0.5 MI SE	TEST TYPE	PUMPING AND RECOVERY
MEASURING EQUIPMENT:	STEEL TAPE AND SOLINST SOUNDER			TEST I.D.	1

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	11	13	95	9	58	t	STATIC LEVEL	17.9 @ 0918 hrs	HOW Q MEASURED	
PUMP OFF	11	13	95	13	43	t'	R.P. LOCATION	HOLE E. SIDE P.B.	DEPTH OF PUMP/AIR LINE	
TEST DURATION	3 HOURS 41 MINUTES						R.P. ELEV:	AT G.S.	PREVIOUS PUMPING?	
									DURATION/END	

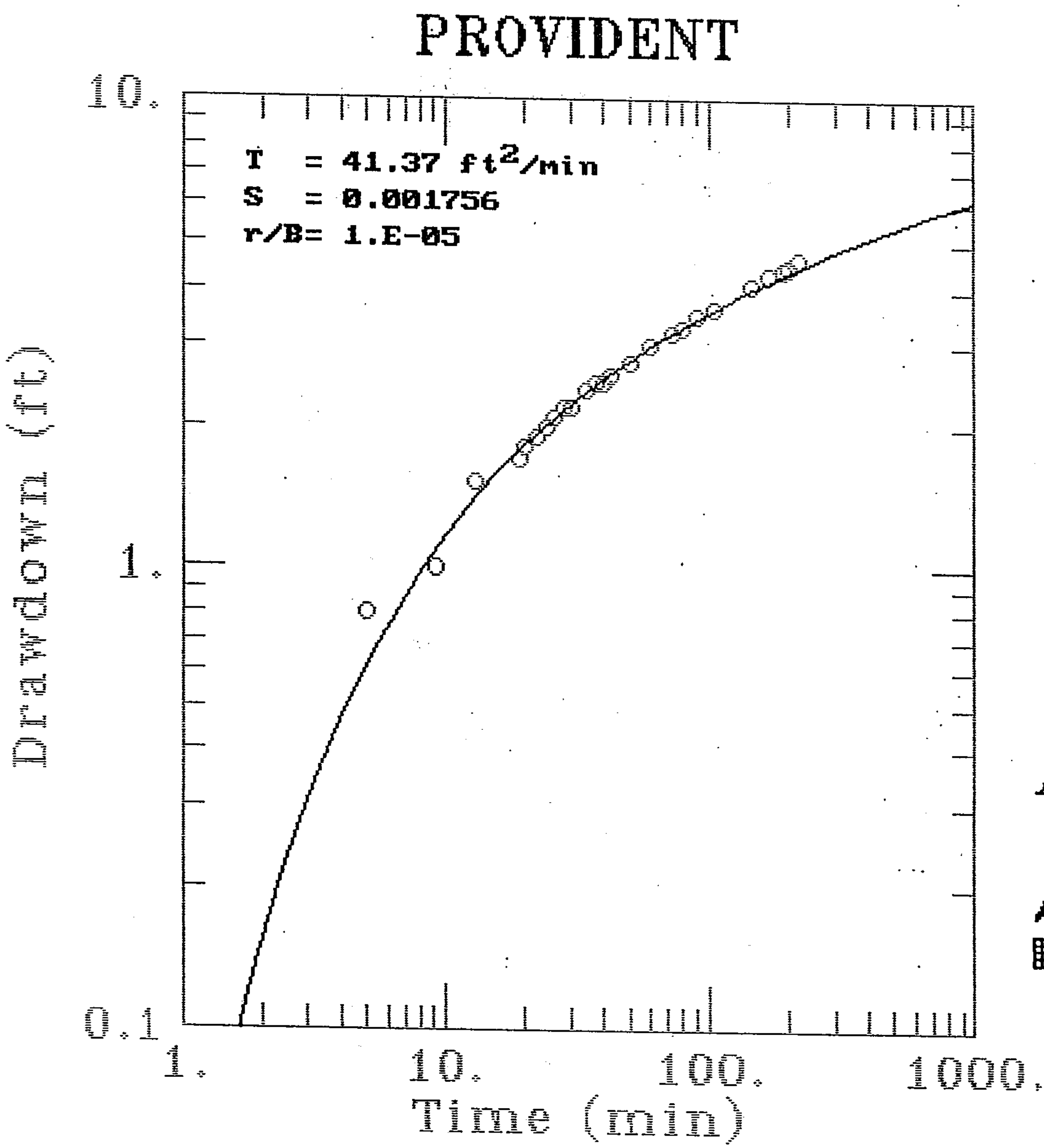
DATE MO	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x 001	RATE GPM	ELEC METER READING KW	COMMENTS
11	13	95			24.0			19.80	1.90				QUESTIONABLE MSMT.
11	13	95			32.0			18.60	0.70				QUESTIONABLE MSMT.
11	13	95			43.0			17.70	-0.20				QUESTIONABLE MSMT.
11	13	95			51.0			18.80	0.90				QUESTIONABLE MSMT.
11	13	95			67.0			19.00	1.10				USING SOUNDER.
11	13	95			79.0			19.00	1.10				
11	13	95			95.0			19.10	1.20				
11	13	95			116.0			19.20	1.30				
11	13	95			145.0			19.30	1.40				
11	13	95			178.0			19.40	1.50				
11	13	95			208.0			19.50	1.60				
													PUMP OFF.
11	13	95			260.0	5.00		19.50	1.60				
11	13	95			261.0	6.00		19.50	1.60				
11	13	95			263.0	8.00		19.40	1.50				
11	13	95			265.0	10.00		19.40	1.50				
11	13	95			267.5	12.50		19.30	1.40				
11	13	95			269.0	14.00		19.30	1.40				
11	13	95			271.0	16.00		19.30	1.40				
11	13	95			280.0	25.00		19.20	1.30				
11	13	95			285.0	30.00		19.20	1.30				
11	13	95			300.0	45.00		19.10	1.20				

AQUIFER TEST DATA

OWNER:	P.I.D. #4	ADDRESS:	ROAD 44 AT ROAD XX	COUNTY: GLENN	STATE: CA
DATE:	11/13/95	ORGANIZATION PERFORMING TEST:	DWR	MEASURED BY:	SCI
WELL NO.:	20N01W30L01M	DISTANCE FROM PUMPING WELL		TEST TYPE	PUMPING AND RECOVERY
MEASURING EQUIPMENT:	BICYCLE PUMP AND AIR GAUGE			TEST I.D.	1

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	11	13	95	9	58	t	STATIC LEVEL	13.5 FT. @ 0930	HOW Q MEASURED	FLOW METER
PUMP OFF	11	13	95	13	43	t'	R.P. LOCATION	HOLE IN N.SIDE P.B.	DEPTH OF PUMP/AIR LINE	
TEST DURATION	3 HOURS 41 MINUTES						R.P. ELEV:	0.0 FT. FROM G.S.	PREVIOUS PUMPING?	
									DURATION/END	

DATE MO	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
11	13	95			1.0			45.00	31.50				1650 R.P.M.
11	13	95			2.0			45.00	31.50				
11	13	95			3.0			45.00	31.50				
11	13	95			4.0			45.00	31.50				
11	13	95			5.0			45.00	31.50				
11	13	95			6.0			45.00	31.50				
11	13	95			7.0			45.00	31.50				
11	13	95			8.0			45.00	31.50				
11	13	95			9.0			45.00	31.50				
11	13	95			10.0			45.00	31.50		4500		METER READS 310,256
11	13	95			20.0			45.00	31.50		4500		
11	13	95			25.0			45.00	31.50		4500		
11	13	95			30.0			45.00	31.50		4500		
11	13	95			35.0			45.00	31.50		4500		
11	13	95			40.0			45.00	31.50		4500		
11	13	95			45.0			45.00	31.50		4500		
11	13	95			50.0			45.00	31.50		4500		
11	13	95			55.0			45.00	31.50		4500		
11	13	95			60.0			45.00	31.50		4500		
11	13	95			65.0			45.00	31.50		4500		
11	13	95			70.0			45.00	31.50		4500		
11	13	95			75.0			45.00	31.50		4500		
11	13	95			80.0			45.00	31.50		4400		
11	13	95			85.0			45.00	31.50		4400		
11	13	95			90.0			45.00	31.50		4400		
11	13	95			95.0			45.00	31.50		4400		
11	13	95			100.0			45.00	31.50		4400		
11	13	95			122.0			45.00	31.50		4400		
11	13	95			186.0			45.00	31.50		4400		
11	13	95			219.0						0		GEARED DOWN.
11	13	95			220.0			25.00	11.50				METER READS 313,131
11	13	95			221.0								PUMP OFF.
11	13	95			246.0	21.0		22.00	8.50				
11	13	95			275.0	50.0		21.00	7.50				

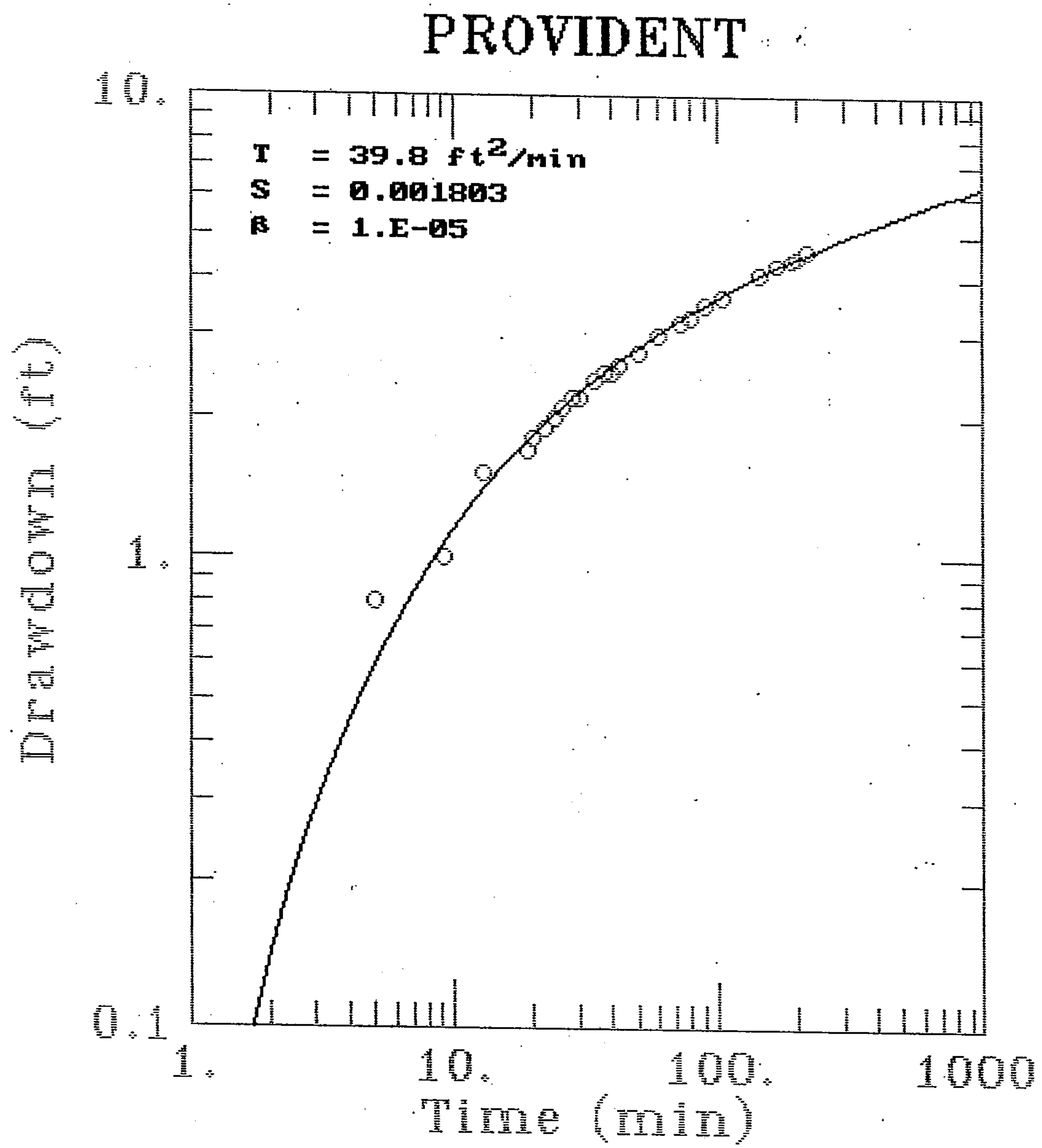


AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

Hantush Leaky
(no aquitard storage)
Provident #4



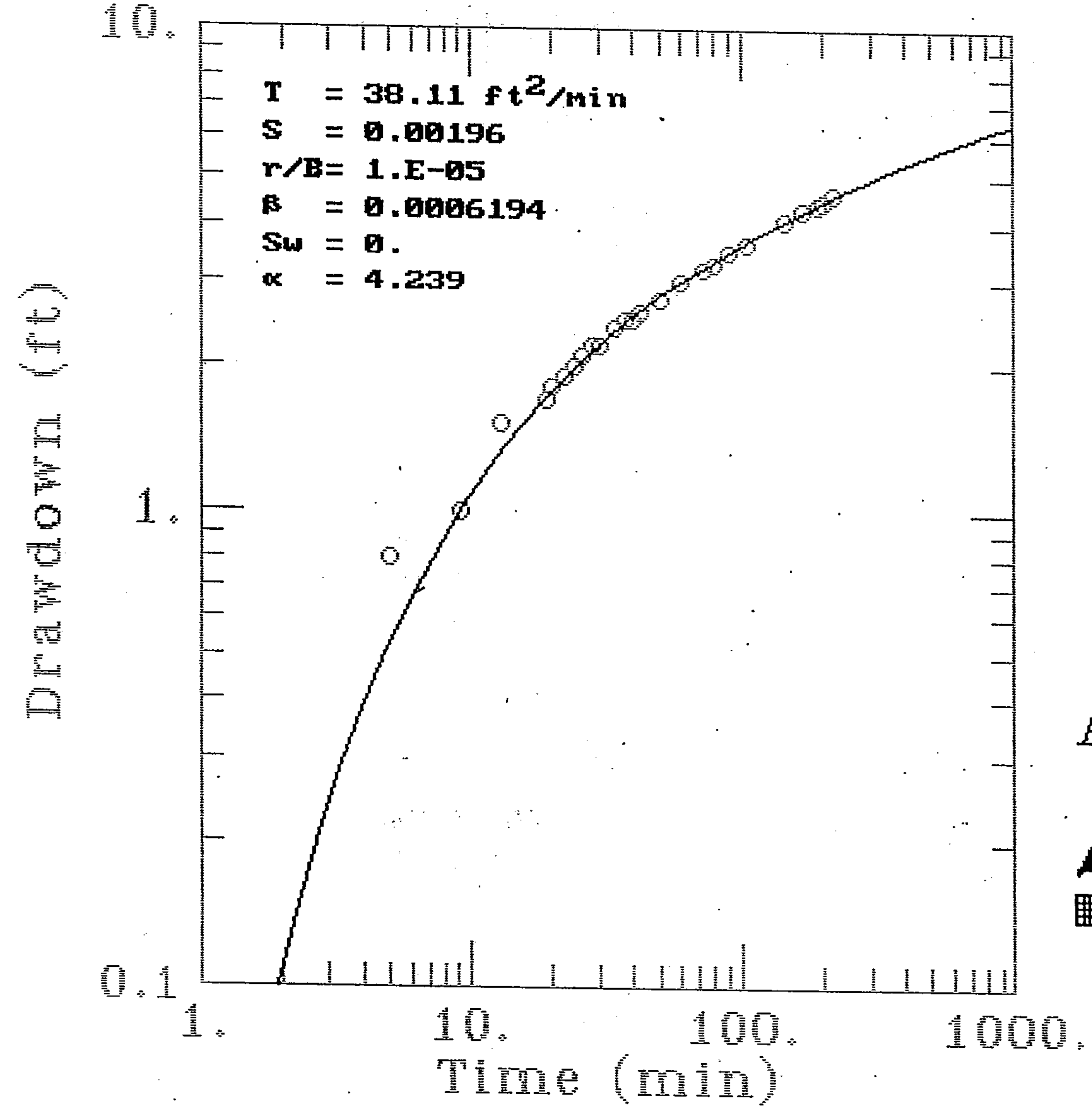
AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

Hantush Leaky Equation
(with aquitard storage)
Provident #4

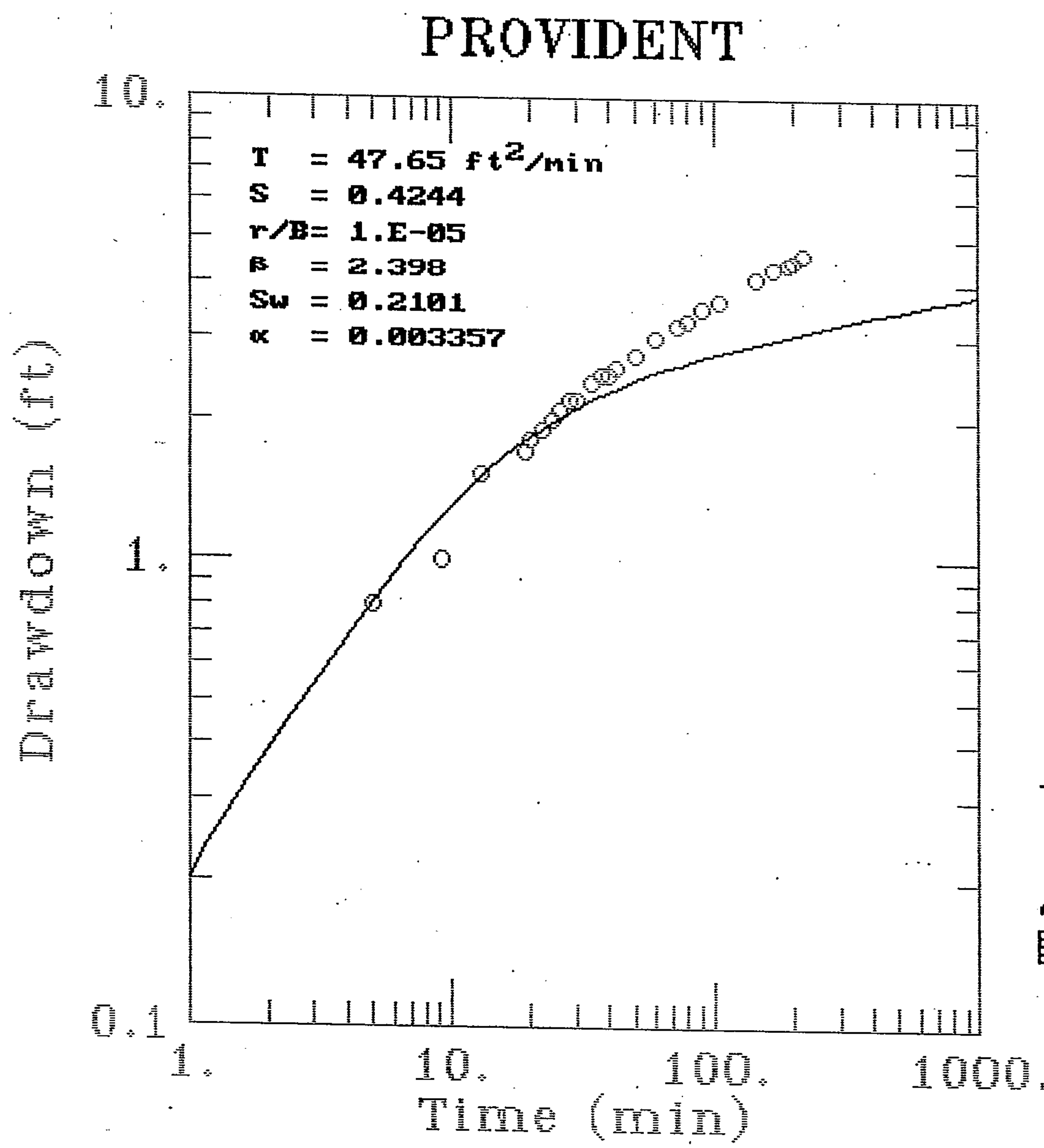
PROVIDENT



AQTESOLV

GERAGHTY & MILLER, INC.
Modeling Group

Moench Equation
Provident #4



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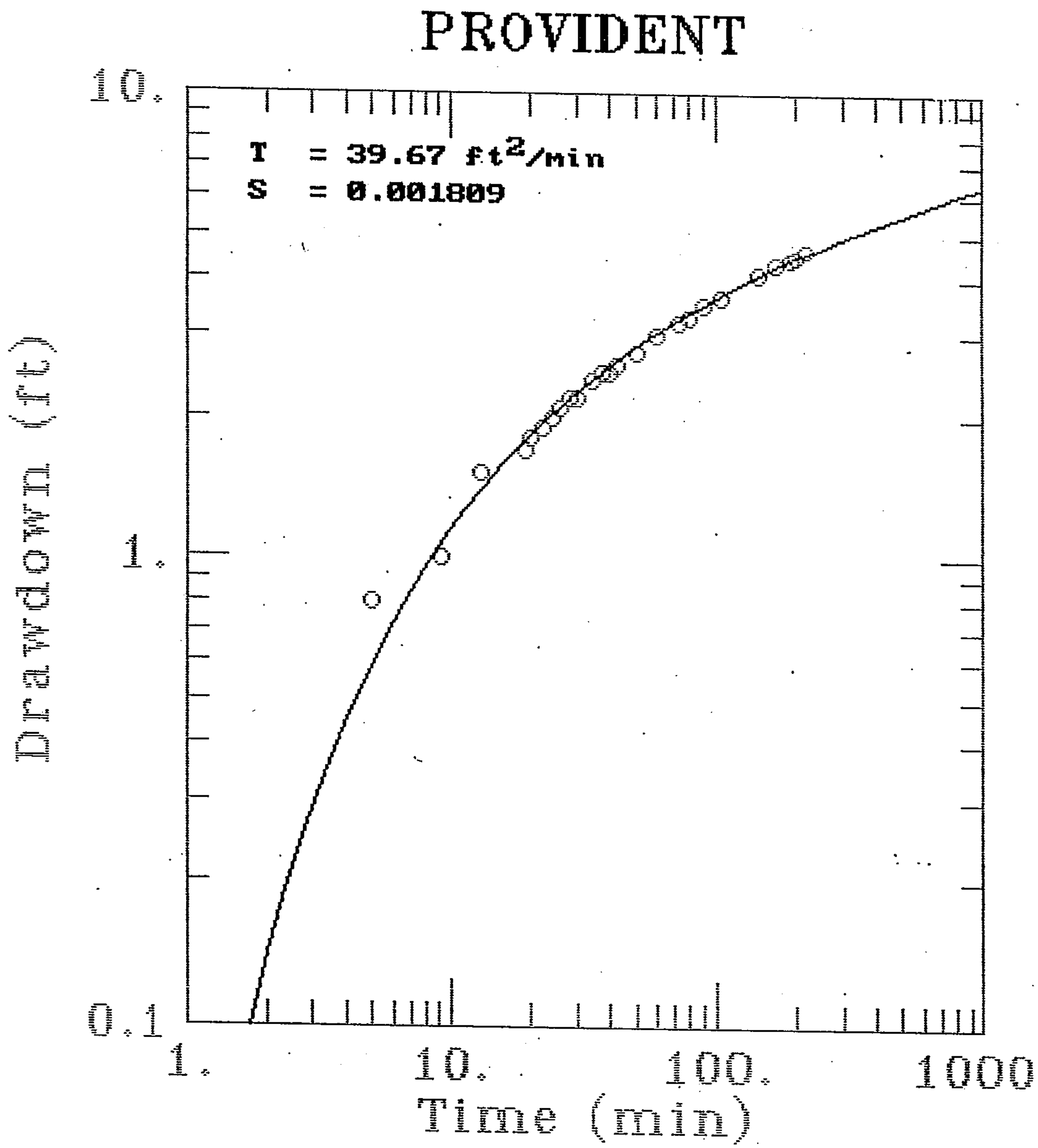
GERAGHTY & MILLER, INC.

Modeling Group

Moench Equation
Provident #3



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GERAGHTY & MILLER, INC.

Theis Equation
Provident #4

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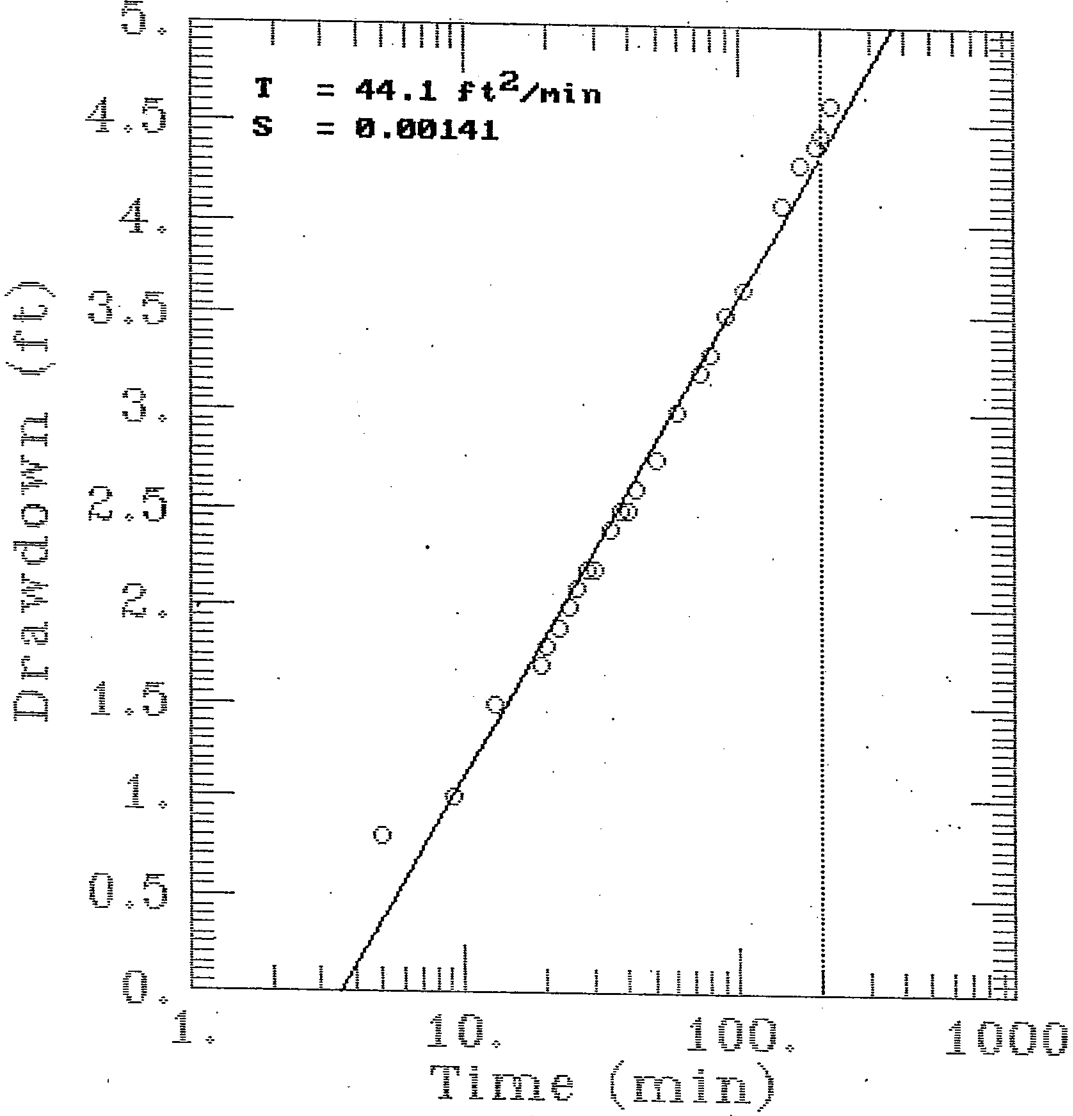


AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

Cooper-Jacob Equation
Provident #4

APPENDIX C 2
MAIN AQUIFER TEST DATA

AQUIFER TEST DATA

OWNER: PID #2 ADDRESS: SE CORNER RDS 44 & X COUNTY: GLENN STATE: CA
DATE: 02/01/96 ORGANIZATION PERFORMING TES DWR MEASURED BY: DMC/KYB/WCL/JSH/SCI
WELL NO.: 20N02W25J02M DISTANCE FROM PUMPING WELL 0.5 MI W TEST TYP PUMP/DRAWDOWN
MEASURING EQUIPMENT: POWERS SOUNDER/STEEL TAPE TEST I.D. 2

TIME DATA	DATE MO DY YR	TIME HR MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	2 1 96	9 28	t	STATIC LEVEL	2.1 RP-WS	HOW Q MEASURED	
PUMP OF	2 4 96	16 25	t'	R.P. LOCATION	0.1	DEPTH OF PUMP/AIR LINE	
TEST DURATION		79 HOURS		R.P. ELEV:	97	PREVIOUS PUMPING?	
						DURATION/END	

DATE M	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
2	1	96	8	19				2.10	0.00				PRE-TEST MSMT-TAPE
2	1	96	9	28									PUMP ON
2	1	96	9	46	18.0			2.30	0.20				
2	1	96	9	49	21.0			2.30	0.20				
2	1	96	10	2	34.0			2.40	0.30				
2	1	96	10	22	54.0			2.60	0.50				
2	1	96	10	37	69.0			2.70	0.60				
2	1	96	11	48	140.0			3.35	1.25				
2	1	96	12	21	173.0			3.60	1.50				
2	1	96	13	5	217.0			3.90	1.80				
2	1	96	14	4	276.0			4.15	2.05				
2	1	96	15	4	336.0			4.40	2.30				
2	1	96	15	18	350.0			4.50	2.40				
2	2	96	8	35	1387.0			6.20	4.10				TAPE
2	2	96	14	59	1771.0			4.60	2.50				TAPE
2	3	96	11	55	3027.0			7.10	5.00				TAPE
2	4	96	15	55	4707.0			6.90	4.80				TAPE
2	4	96	16	25									PUMP OFF
2	5	96	15	23	6115.0			1.50	-0.60				TAPE

AQUIFER TEST DATA

OWNER: PID #3 ADDRESS: RD 44 BETWEEN RDS X AND XX COUNTY: G;ENN STATE: CA
DATE: 02/01/96 ORGANIZATION PERFORMING TES DWR MEASURED BY: DMC/KYB/WCL/JSH/SCI
WELL NO.: 20N02W25J03M DISTANCE FROM PUMPING WELL 0.25 MI W TEST TYP PUMP/DRAWDOWN
MEASURING EQUIPMENT: POWERS SOUNDER/STEEL TAPE TEST I.D. 2

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	2	1	96	9	28	t	STATIC LEVEL	8.9 RP-WS	HOW Q MEASURED	
PUMP OF	2	4	96	16	25	t'	R.P. LOCATION	0.4	DEPTH OF PUMP/AIR LINE	
TEST DURATION				79 HOURS			R.P. ELEV:	103	PREVIOUS PUMPING?	
									DURATION/END	

DATE M	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
2	1	96						8.90	0.00				PRE-TEST MSMT-TAPE
2	1	96	9	28									PUMP ON
2	1	96	9	32	4.0			9.40	0.50				
2	1	96	9	34	6.0			9.45	0.55				
2	1	96	9	35	7.0			9.50	0.60				
2	1	96	9	36	8.0			9.60	0.70				
2	1	96	9	37	9.0			9.70	0.80				
2	1	96	9	38	10.0			9.75	0.85				
2	1	96	9	39	11.0			9.80	0.90				
2	1	96	9	40	12.0			9.90	1.00				
2	1	96	9	41	13.0			9.95	1.05				
2	1	96	9	42	14.0			10.00	1.10				
2	1	96	9	43	15.0			10.05	1.15				
2	1	96	9	53	25.0			10.50	1.60				
2	1	96	9	57	29.0			10.70	1.80				
2	1	96	10	6	38.0			11.00	2.10				
2	1	96	10	11	43.0			11.10	2.20				
2	1	96	10	17	49.0			11.30	2.40				
2	1	96	10	25	57.0			11.45	2.55				
2	1	96	10	31	63.0			11.60	2.70				
2	1	96	10	57	89.0			11.95	3.05				
2	1	96	11	6	98.0			12.10	3.20				
2	1	96	11	26	118.0			12.40	3.50				
2	1	96	11	44	136.0			12.50	3.60				
2	1	96	12	18	160.0			12.90	4.00				
2	1	96	13	0	209.0			13.20	4.30				
2	1	96	14	0	329.0			13.50	4.60				
2	1	96	15	0	389.0			13.80	4.90				
2	1	96	15	15	404.0			13.85	4.95				
2	2	96	8	30	1382.0			14.80	5.90				TAPE
2	2	96	14	48	1760.0			15.90	7.00				TAPE
2	3	96	11	48	3020.0			16.50	7.60				TAPE
2	4	96	15	45	4697.0			16.45	7.55				TAPE
2	4	96	16	25	4737.0								PUMP OFF
2	5	96	14	0	6032.0			6.90	-2.00				TAPE

AQUIFER TEST DATA

OWNER: SOUZA
ADDRESS: SW CORNER HWY 45 & RD 44
COUNTY: GLENN
STATE: CA
DATE: 02/01/96
ORGANIZATION PERFORMING TES DWR
MEASURED BY: DMC/JSH/SCI
WELL NO.: 20N01W29M02M
DISTANCE FROM PUMPING WELL 0.75 MI E
TEST TYP PUMP/DRAWDOWM
MEASURING EQUIPMENT: SOLINST SOUNDER & STEEL TAPE
TEST I.D. 2

TIME DATA	DATE MO DY YR	TIME HR MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	2 1 96	9 28	t	STATIC LEVEL	12.8 RP-WS	HOW Q MEASURED	
PUMP OF	2 4 96	16 25	t'	R.P. LOCATION	0.2	DEPTH OF PUMP/AIR LINE	
TEST DURATION		79 HOURS		R.P. ELEV:	102.8	PREVIOUS PUMPING?	
						DURATION/END	

DATE M	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
2	1	96	7	50				12.80	0.00				PRE-TEST MSMT - TAPE
2	1	96	9	28									PUMP ON
2	1	96	10	42	74.0			13.00	0.20				SOUNDER
2	1	96	11	53	145.0			13.00	0.20				TAPE
2	1	96	12	57	209.0			13.10	0.30				SOUNDER
2	1	96	14	3	275.0			13.18	0.38				SOUNDER
2	1	96	14	57	329.0			13.25	0.45				SOUNDER
2	1	96	15	50	382.0			13.30	0.50				TAPE
2	2	96	7	35	2207.0			14.00	1.20				TAPE
2	2	96	14	37	1749.0			14.20	1.40				TAPE
2	3	96	11	18	2990.0			15.20	2.40				TAPE
2	4	96	15	18	4670.0			13.20	0.40				TAPE
2	4	96	16	25	*********								PUMP OFF
2	5	96	13	11	5983.0			5.90	-6.90				TAPE

AQUIFER TEST DATA

OWNER: CORREIA
ADDRESS: 5160 ROAD 44
COUNTY: GLENN
STATE: CA
DATE: 2 02/01/96
ORGANIZATION PERFORMING TES DWR
MEASURED BY: DMC/WCL/JSH/SCI
WELL NO.: 20N01W30G01M
DISTANCE FROM PUMPING WELL 0.5 MI E
TEST TYP PUMP/DRAWDOWN
MEASURING EQUIPMENT: STEEL TAPE
TEST I.D. 2

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	2	1	96	9	28	t	STATIC LEVEL	12.8 RP-WS	HOW Q MEASURED	
PUMP OF	2	4	96	16	25	t'	R.P. LOCATION		DEPTH OF PUMP/AIR LINE	
							R.P. ELEV:		PREVIOUS PUMPING?	
TEST DURATION				79 HOURS					DURATION/END	

DATE M	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
2	1	96	8	0				12.80	0.00				PRE-TEST MSMT - QM 4
2	1	96	9	28									PUMP ON
2	1	96	10	39	88.0			13.60	0.80				
2	1	96	11	17	108.0			13.70	0.90				
2	1	96	11	56	148.0			13.80	1.00				
2	1	96	13	0	212.0			14.00	1.20				
2	1	96	13	53	265.0			14.10	1.30				
2	1	96	14	49	321.0			14.20	1.40				
2	1	96	15	42	374.0			14.25	1.45				
2	2	96	7	35	1337.0			15.10	2.30				
2	2	96	14	39	1751.0			15.40	2.60				
2	3	96	11	32	3004.0			16.10	3.30				
2	4	96	15	25	4677.0			12.80	0.00				
2	4	96	16	25	*********								PUMP OFF
2	5	96	13	23	5995.0			9.00	-3.80				

AQUIFER TEST DATA

OWNER: WEIR RANCH ADDRESS: ROAD 44 COUNTY: GLENN STATE: CA
DATE: 02/01/96 ORGANIZATION PERFORMING TES DWR MEASURED BY: DMC/JSH/SCI
WELL NO.: 20N01W30H01M DISTANCE FROM PUMPING WELL 0.65 MI E TEST TYP PUMP/DRAWDOWN
MEASURING EQUIPMENT: STEEL TAPE TEST I.D. 2

TIME DATA	DATE MO DY YR	TIME HR MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	2 1 96	9 28	t	STATIC LEVEL	11.8 RP-WS	HOW Q MEASURED	
PUMP OF	2 4 96	16 25	t'	R.P. LOCATION	0	DEPTH OF PUMP/AIR LINE	
TEST DURATION		79 HOURS		R.P. ELEV:	102.1	PREVIOUS PUMPING?	
						DURATION/END	

DATE M	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
2	1	96	7	55				11.80	0.00				PRE-TEST MSMT
2	1	96	9	28									PUMP ON
2	1	96	10	32	64.0			12.00	0.20				
2	1	96	11	44	136.0			12.10	0.30				
2	1	96	12	49	201.0			12.15	0.35				
2	1	96	13	57	269.0			12.25	0.45				WORKER SAID PUMP
2	1	96	14	53	325.0			12.33	0.52				USED VERY LITTLE
2	1	96	15	46	378.0			12.40	0.60				TODAY.
2	2	96	7	40	1332.0			13.10	1.30				
2	2	96	14	38	1750.0			13.50	1.70				QM4
2	3	96	11	27	2999.0			14.30	2.50				QM4
2	4	96	15	31	4683.0			14.90	3.10				
2	4	96	16	25									PUMP OFF
2	5	96	13	16	5988.0			6.70	-5.10				

AQUIFER TEST DATA

OWNER: BERTAPELLE ADDRESS: SE OF RDS 44 & XX COUNTY: GLENN STATE: CA
DATE: 02/01/96 ORGANIZATION PERFORMING TES DWR MEASURED BY: DMC/JSH/SCI
WELL NO.: 20N01W30K02M DISTANCE FROM PUMPING WELL 0.3 MI E TEST TYP PUMP/DRAWDOWN
MEASURING EQUIPMENT: SOLINST SOUNDER & STEEL TAPE TEST I.D. 2

TIME DATA						WATER LEVEL DATA		DISCHARGE DATA	
	DATE			TIME					
	MO	DY	YR	HR	MIN				
PUMP ON	2	1	96	9	28 t.	STATIC LEVEL	10.4 RP-WS	HOW Q MEASURED	
PUMP OF					t'	R.P. LOCATION	0.5	DEPTH OF PUMP/AIR LINE	
TEST DURATION				**** HOURS		R.P. ELEV:	102	PREVIOUS PUMPING?	
								DURATION/END	

DATE M	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
2	1	96	9	25		0		10.40	0.00				PRE-TEST MSMT - SND
2	1	96	9	28	0.0	0		10.40	0.00				PUMP ON
2	1	96	9	29	1.0	0		10.45	0.05				SOUNDER
2	1	96	9	30	2.0	0		10.50	0.10				SOUNDER
2	1	96	9	31	3.0	0		10.50	0.10				SOUNDER
2	1	96	9	32	4.0	0		10.50	0.10				SOUNDER
2	1	96	9	33	5.0	0		10.53	0.13				SOUNDER
2	1	96	9	34	6.0	0		10.53	0.13				SOUNDER
2	1	96	9	35	7.0	0		10.55	0.15				SOUNDER
2	1	96	9	36	8.0	0		10.55	0.15				SOUNDER
2	1	96	9	37	9.0	0		10.55	0.15				SOUNDER
2	1	96	9	38	10.0	0		10.55	0.15				SOUNDER
2	1	96	9	39	11.0	0		10.58	0.18				SOUNDER
2	1	96	9	40	12.0	0		10.58	0.18				SOUNDER
2	1	96	9	41	13.0	0		10.60	0.20				SOUNDER
2	1	96	9	42	14.0	0		10.60	0.20				SOUNDER
2	1	96	9	43	15.0	0		10.60	0.20				SOUNDER
2	1	96	9	48	20.0	0		10.70	0.30				SOUNDER
2	1	96	9	53	25.0	0		10.73	0.33				SOUNDER
2	1	96	9	58	30.0	0		10.78	0.38				SOUNDER
2	1	96	10	3	35.0	0		10.83	0.43				SOUNDER
2	1	96	10	8	40.0	0		10.88	0.48				SOUNDER
2	1	96	10	13	45.0	0		10.91	0.51				SOUNDER
2	1	96	10	18	50.0	0		10.98	0.58				SOUNDER
2	1	96	10	23	55.0	0		11.00	0.60				SOUNDER
2	1	96	10	28	60.0	0		11.03	0.63				SOUNDER
2	1	96	10	47	79.0	0		11.15	0.75				SOUNDER
2	1	96	10	58	90.0	0		11.21	0.81				SOUNDER
2	1	96	11	13	105.0	0		11.30	0.90				SOUNDER
2	1	96	11	28	120.0	0		11.40	1.00				SOUNDER
2	1	96	12	3	155.0	0		11.50	1.10				SOUNDER
2	1	96	13	6	218.0	0		11.68	1.28				SOUNDER
2	1	96	13	46	258.0	0		11.75	1.35				SOUNDER
2	1	96	14	43	315.0	0		11.88	1.48				SOUNDER
2	1	96	15	30	362.0	0		11.95	1.55				SOUNDER
2	2	96	8	20	1372.0	0		12.90	2.50				TAPE
2	2	96	14	44	1756.0	0		12.90	2.50				TAPE
2	3	96	11	40	3012.0	0		13.80	3.40				TAPE
2	4	96	15	38	4690.0	0		12.80	2.40				TAPE
2	4	96	16	25	*********	0							PUMP OFF
2	5	96	13	32	6004.0	0		6.70	-3.70				TAPE

AQUIFER TEST DATA

OWNER: BARJAYDEE, INC ADDRESS: SE OF RDS 44 & XX COUNTY: GLENN STATE: CA
DATE: 02/01/96 ORGANIZATION PERFORMING TES DWR MEASURED BY: DMC/JSH/SCL[illegible]
WELL NO.: 20N01W30K03M DISTANCE FROM PUMPING WELL 0.3 MI E TEST TYP PUMP/DRAWDOWN
MEASURING EQUIPMENT: SOLINST SOUNDER & STEEL TAPE TEST I.D. 2

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	2	1	96	9	28	t	STATIC LEVEL	10.2 RP-WS	HOW Q MEASURED	
PUMP OF	2	4	96	16	25	t'	R.P. LOCATION	0	DEPTH OF PUMP/AIR LINE	
TEST DURATION				79 HOURS			R.P. ELEV:	101.3	PREVIOUS PUMPING?	
									DURATION/END	

DATE M	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
2	1	96						10.20	0.00				PRE-TEST MSMT - TAPE
2	1	96	9	28									PUMP ON
2	1	96	9	45	17.0			10.50	0.30				SOUNDER
2	1	96	9	49	21.0			10.50	0.30				SOUNDER
2	1	96	9	54	26.0			10.60	0.40				SOUNDER
2	1	96	9	59	31.0			10.65	0.45				SOUNDER
2	1	96	10	4	36.0			10.68	0.48				SOUNDER
2	1	96	10	9	41.0			10.70	0.50				SOUNDER
2	1	96	10	14	46.0			10.78	0.57				SOUNDER
2	1	96	10	19	51.0			10.80	0.60				SOUNDER
2	1	96	10	24	56.0			10.85	0.65				SOUNDER
2	1	96	10	29	61.0			10.90	0.70				SOUNDER
2	1	96	10	48	80.0			11.00	0.80				SOUNDER
2	1	96	10	58	90.0			11.05	0.85				SOUNDER
2	1	96	11	14	106.0			11.10	0.90				SOUNDER
2	1	96	11	29	121.0			11.20	1.00				SOUNDER
2	1	96	12	4	156.0			11.30	1.10				SOUNDER
2	1	96	13	9	221.0			11.50	1.30				SOUNDER
2	1	96	13	48	260.0			11.60	1.40				SOUNDER
2	1	96	14	44	316.0			11.70	1.50				SOUNDER
2	1	96	15	31	363.0			11.75	1.55				SOUNDER
2	2	96	8	22	1374.0			12.80	2.60				TAPE
2	2	96	14	43	1755.0			13.10	2.90				TAPE
2	3	96	11	42	3014.0			13.60	3.40				TAPE
2	4	96	15	39	4691.0			12.60	2.40				TAPE
2	4	96	16	25	*********								PUMP OFF
2	5	96	13	34	6006.0			6.50	-3.70				TAPE

AQUIFER TEST DATA

OWNER: SOUTHAM
ADDRESS: SE OF RDS 44 & WW
COUNTY: GLENN
STATE: CA
DATE: 02/01/96
ORGANIZATION PERFORMING TES DWR
MEASURED BY: DMC/KYB/WCL/JSH/SCI
WELL NO.: 20N02W25L02M
DISTANCE FROM PUMPING WELL 1.0 MI W
TEST TYP PUMP/DRAWDOWN
MEASURING EQUIPMENT: SOLINST SOUNDER/POWERS SOUNDER/STEEL TAP
TEST I.D. 2

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	2	1	96	9	28	t	STATIC LEVEL	1.2 RP-WS	HOW Q MEASURED	
PUMP OF	2	4	96	16	25	t'	R.P. LOCATION	2.2	DEPTH OF PUMP/AIR LINE	
TEST DURATION	79 HOURS						R.P. ELEV:	102.2	PREVIOUS PUMPING?	
									DURATION/END	

DATE M	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
2	1	96	8	58				1.10	-0.10				PRE-TEST MSMT-SOLIN
2	1	96	9	28									PUMP ON
2	1	96	10	42	74.0			1.25	0.05				POWERS
2	1	96	11	13	105.0			1.20	0.00				POWERS
2	1	96	11	55	147.0			1.20	0.00				POWERS
2	1	96	12	26	178.0			1.32	0.12				POWERS
2	1	96	13	10	222.0			1.39	0.19				POWERS
2	1	96	14	8	280.0			1.41	0.21				POWERS
2	1	96	15	7	339.0			1.41	0.21				POWERS
2	1	96	15	20	352.0			1.42	0.22				POWERS
2	2	96	8	40	1392.0			1.90	0.70				TAPE
2	2	96	14	50	1722.0			1.90	0.70				TAPE
2	3	96	12	19	3051.0			2.30	1.10				TAPE
2	4	96	16	5	4717.0			1.80	0.60				TAPE
2	4	96	16	25	4737.0								PUMP OFF
2	5	96	14	32	6064.0			0.60	-0.60				

AQUIFER TEST DATA

OWNER: GARCIA
ADDRESS: SE OF RDS 44 & V
COUNTY: GLENN
STATE: CA
DATE: 02/01/96
ORGANIZATION PERFORMING TES DWR
MEASURED BY: DMC/KYB/WCL/JSH/SCI
WELL NO.: 20N02W27J02M
DISTANCE FROM PUMPING WELL 2.25 MI W
TEST TYP PUMP/DRAWDOWN
MEASURING EQUIPMENT: SOLINST SOUNDER/POWERS SOUNDER/STEEL TAP
TEST I.D. 2

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	2	1	96	9	28	t	STATIC LEVEL	4.2 RP-WS	HOW Q MEASURED	
PUMP OF	2	4	96	16	25	t'	R.P. LOCATION	0.8	DEPTH OF PUMP/AIR LINE	
TEST DURATION	79 HOURS						R.P. ELEV:	103.7	PREVIOUS PUMPING?	
									DURATION/END	

DATE M	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
2	1	96	8	53				4.20	0.00				PRE-TEST MSMT-SOLIN
2	1	96	9	28	0.0								PUMP ON
2	1	96	10	48	80.0			4.30	0.10				POWERS SOUNDER
2	1	96	11	18	110.0			4.30	0.10				
2	1	96	12	4	156.0			4.30	0.10				
2	1	96	12	30	182.0			4.30	0.10				
2	1	96	13	15	227.0			4.30	0.10				
2	1	96	14	13	285.0			4.32	0.12				
2	1	96	15	10	342.0			4.33	0.13				
2	1	96	15	25	357.0			4.33	0.13				
2	2	96	8	50	1402.0			4.50	0.30				TAPE
2	2	96	14	51	1763.0			6.40	2.20				TAPE
2	3	96	12	11	3043.0			4.80	0.60				TAPE
2	4	96	16	8	4720.0			4.00	-0.20				TAPE
2	4	96	16	25									PUMP
2	5	96	14	37	6069.0			3.60	-0.60				TAPE

AQUIFER TEST DATA

OWNER: PROVIDENT #4   ADDRESS: SW CORNER RD 44 & RD XX   COUNTY: GLENN   STATE: CA
DATE: 02/01/96   ORGANIZATION PERFORMING TES DWR   MEASURED BY: DMC/WCL/JSH
WELL NO.: 20N01W30L01M   DISTANCE FROM PUMPING WELL TEST WEL   TEST TYP PUMP/DRAWDOWN
MEASURING EQUIPMENT: POWERS SOUNDER   TEST I.D. 2

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
PUMP ON	2	1	96	9	28	t	STATIC LEVEL	7.7 RP-WS	HOW Q MEASURED	
PUMP OF	2	4	96	16	25	t'	R.P. LOCATION		DEPTH OF PUMP/AIR LINE	
							R.P. ELEV:		PREVIOUS PUMPING?	
TEST DURATION	79 HOURS								DURATION/END	

DATE M	DY	YR	CLOCK TIME HR	MIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x .001	RATE GPM	ELEC METER READING KW	COMMENTS
2	1	96	8	11				7.70	0.00	313,303			PRE-TEST MSMT
2	1	96	9	28	0.0								PUMP ON @ 1650 RPM
2	1	96	9	28	0.5			29.70	22.00				
2	1	96	9	29	1.5			29.20	21.50				
2	1	96	9	29	1.9			29.90	22.20				
2	1	96	9	30	2.5			29.80	22.10				
2	1	96	9	31	3.0			31.50	23.80				
2	1	96	9	31	3.5			31.60	23.90				
2	1	96	9	32	4.3			31.70	24.00				
2	1	96	9	33	5.0			31.90	24.20				
2	1	96	9	33	5.5			32.10	24.40		5000		
2	1	96	9	34	6.3			32.15	24.45				
2	1	96	9	34	6.8			31.70	24.00				
2	1	96	9	35	7.5			32.30	24.60				
2	1	96	9	36	8.0			32.35	24.65				
2	1	96	9	36	8.5			32.40	24.70				
2	1	96	9	37	9.0			32.45	24.75				
2	1	96	9	37	9.5			32.50	24.80				
2	1	96	9	38	10.0			32.60	24.90				WQ SAMPLE PW1
2	1	96	9	39	11.0			32.70	25.00				
2	1	96	9	40	12.0			32.70	25.00				
2	1	96	9	41	13.0			32.80	25.10				
2	1	96	9	42	14.0			32.90	25.20		4900		
2	1	96	9	43	15.0			32.95	25.25				
2	1	96	9	44	16.0			33.00	25.30				
2	1	96	9	45	17.0			33.05	25.35				
2	1	96	9	46	18.0			33.15	25.45		4850		
2	1	96	9	47	19.0			33.20	25.50				
2	1	96	9	48	20.0			33.25	25.55				WQ SAMPLE PW2
2	1	96	9	49	21.0			33.35	25.65				
2	1	96	9	50	22.0			33.35	25.65				
2	1	96	9	51	23.0			33.40	25.70		4750	1650	
2	1	96	9	53	25.0			33.50	25.80				
2	1	96	9	58	30.0			33.80	26.10		4725	1650	
2	1	96	10	3	35.0			33.90	26.20		4700	1650	
2	1	96	10	8	40.0			33.90	26.20		4600	1650	WQ SAMPLE PW3
2	1	96	10	13	45.0			33.95	26.25		4550	1650	
2	1	96	10	18	50.0			33.95	26.25		4550	1650	
2	1	96	10	23	55.0			33.90	26.20		4525	1650	
2	1	96	10	28	60.0			33.95	26.25		4450	1650	WQ SAMPLE PW4
2	1	96	10	43	75.0			33.95	26.25		4425	1650	
2	1	96	10	58.0	90.0			34.90	27.20		4400	1625	WQ SAMPLE PW5
2	1	96	11	13.0	105.0			36.10	28.40		4350	1600	CKD W/TAPE
2	1	96	11	28.0	120.0			35.30	27.60		4350	1600	WQ SAMPLE PW6
2	1	96	11	43.0	135.0			35.40	27.70		4450	1650	ADJ THROTTLE
2	1	96	11	58.0	150.0			36.60	28.90		4450	1650	WQ SAMPLE PW7 @ 12
2	1	96	12	58.0	210.0			37.00	29.30	316215	4450	1650	
2	1	96	13	58.0	270.0			37.30	29.60		4450	1650	
2	1	96	14	58.0	330.0			37.60	29.90	318335	4450	1650	
2	1	96	15	25.0	357.0			37.70	30.00		4450	1650	END DAY 1
2	2	96	7	55.0	1347.0			39.60	31.90	332099		1650	
2	2	96	15	10.0	1782.0			39.80	32.10	338009	4450	1650	
2	3	96	12	27.0	2959.0			40.50	32.80	355630	4500	1650	

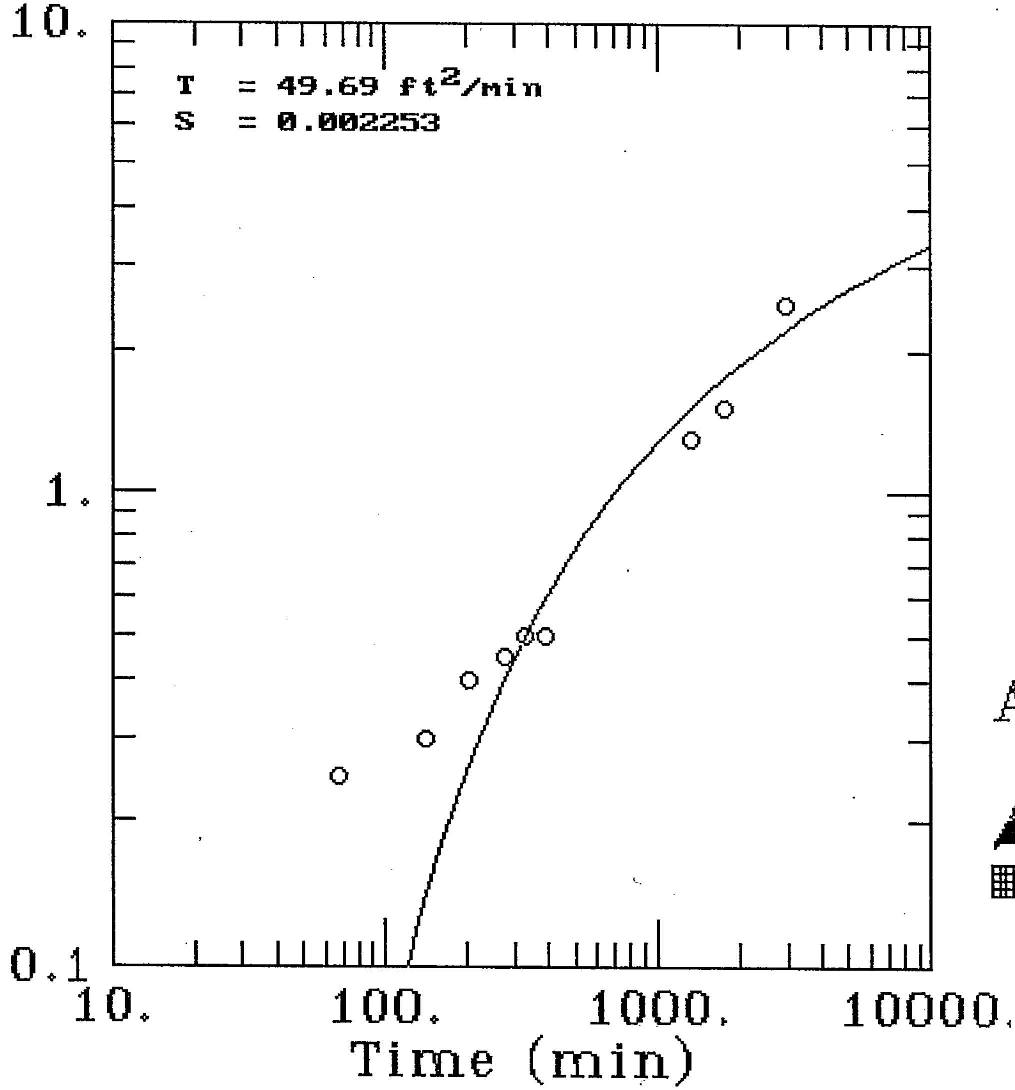
AQUIFER TEST DATA

OWNER:	PROVIDENT #4	ADDRESS:	SW CORNER RD 44 & RD XX	COUNTY:	GLENN	STATE:	CA
DATE:	02/01/96	ORGANIZATION PERFORMING TES	DWR			MEASURED BY:	DMC/WCL/JSH
WELL NO.:	20N01W30L01M	DISTANCE FROM PUMPING WELL	TEST WEL	TEST TYP	PUMP/DRAWDOWN		
MEASURING EQUIPMENT:	POWERS SOUNDER			TEST I.D.	2		

TIME DATA	DATE MO	DY	YR	TIME HR	MIN		WATER LEVEL DATA		DISCHARGE DATA	
							STATIC LEVEL	7.7 RP-WS	HOW Q MEASURED	
PUMP ON	2	1	96	9	28	t	R.P. LOCATION		DEPTH OF PUMP/AIR LINE	
PUMP OF	2	4	96	16	25	t'	R.P. ELEV:		PREVIOUS PUMPING?	
TEST DURATION				79 HOURS					DURATION/END	

DATE M	DY	YR	CLOCK TIME HRMIN	TIME FROM START t	TIME FROM STOP t'	t/t'	GROUND WATER LEVEL	WATER LEVEL CHANGE	CUMULATIVE DISCHARGE AF x 001	RATE GPM	ELEC METER READING KW	COMMENTS
2	4	96	16 16.0	4768.0			40.40	32.70		4450	1700	
2	4	96	16 25.0	4777.0					378756			PUMP OFF
2	5	96	14 15.0	6047.0			6.20	-1.50				

20N01W29M01M TEST 2 OBSERVATION WELL



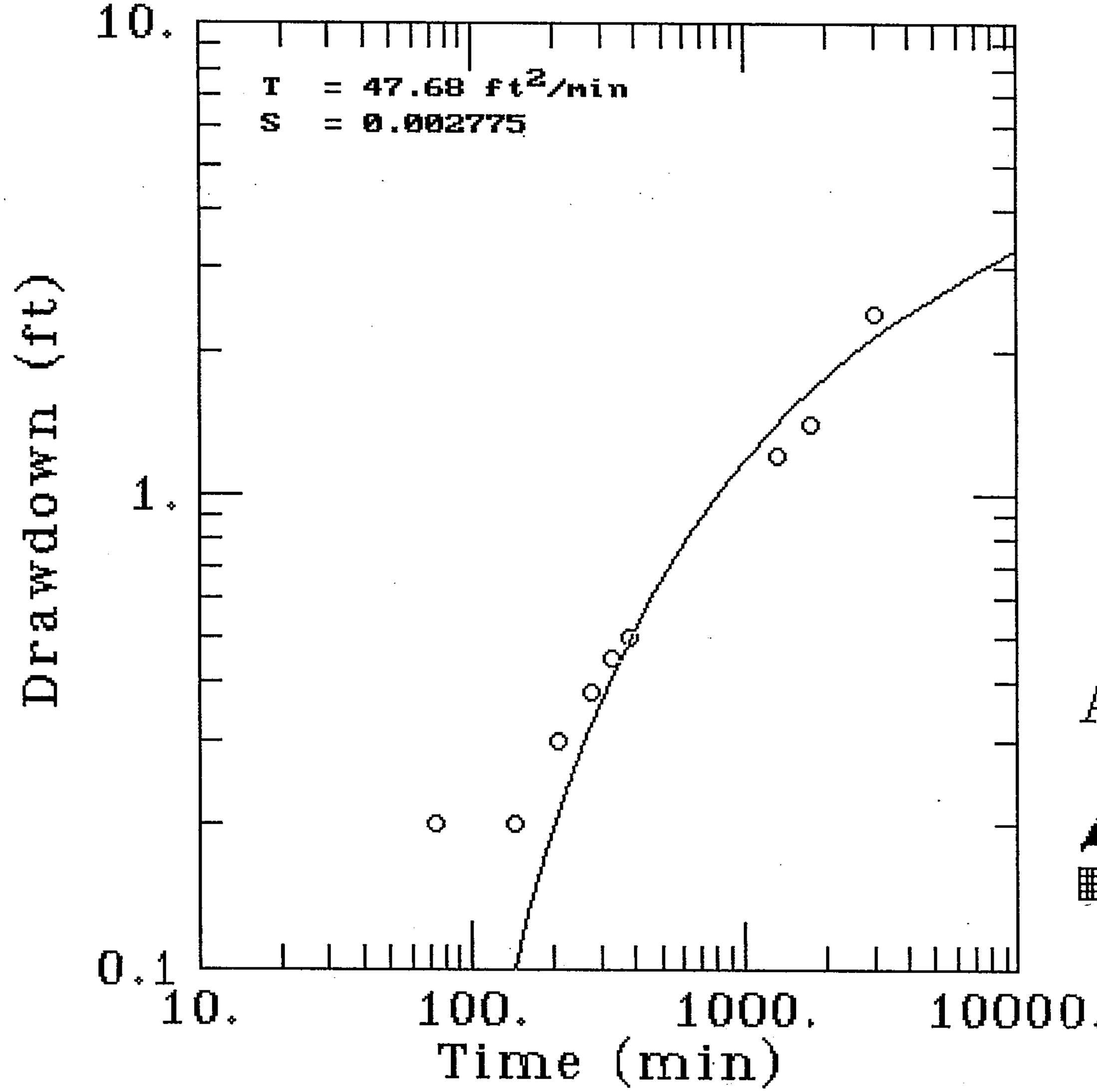
AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

Theis Equation
Well 29M01M

20N01W29M02M TEST 2 OBSERVATION WELL



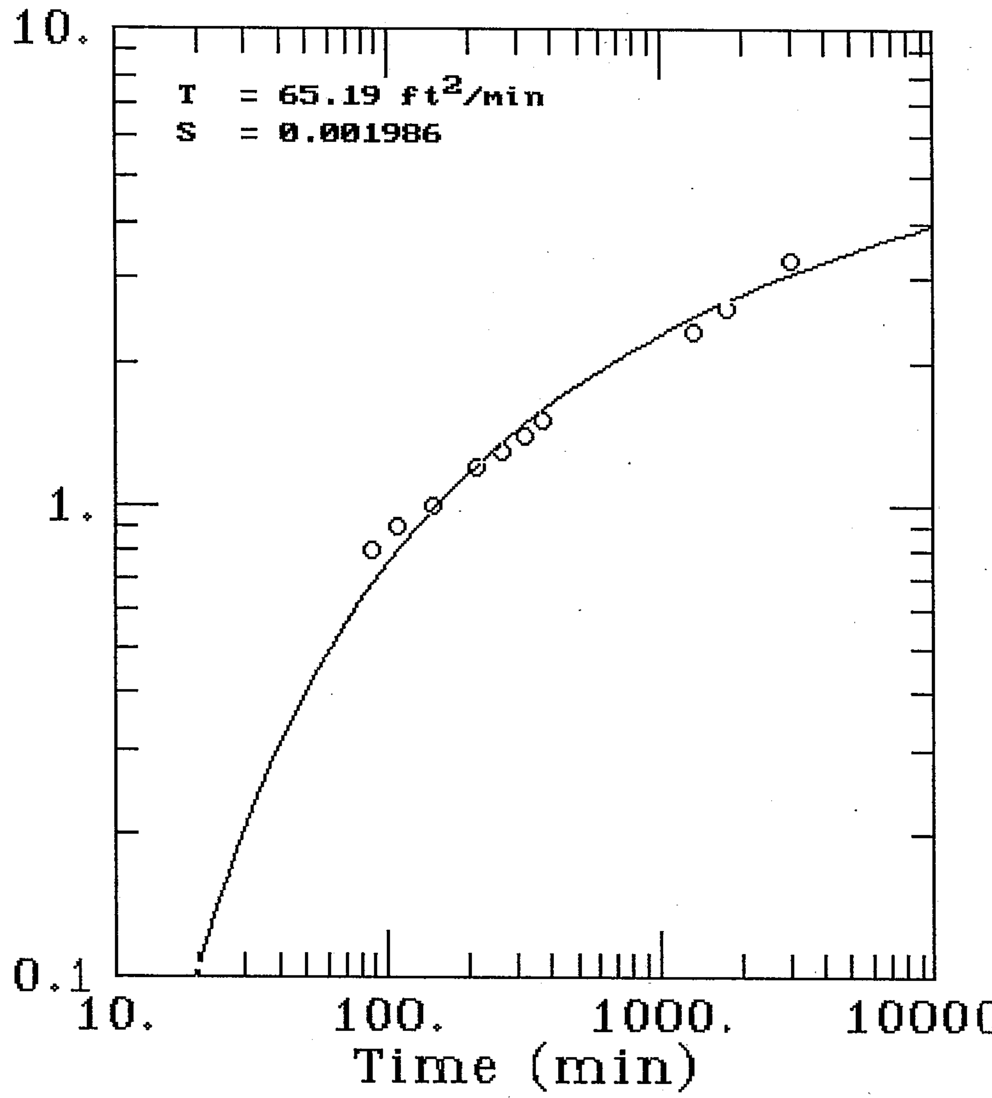
AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

Theis Equation
Well 29M02

20N01W30G01M TEST 2 OBSERVATION WELL



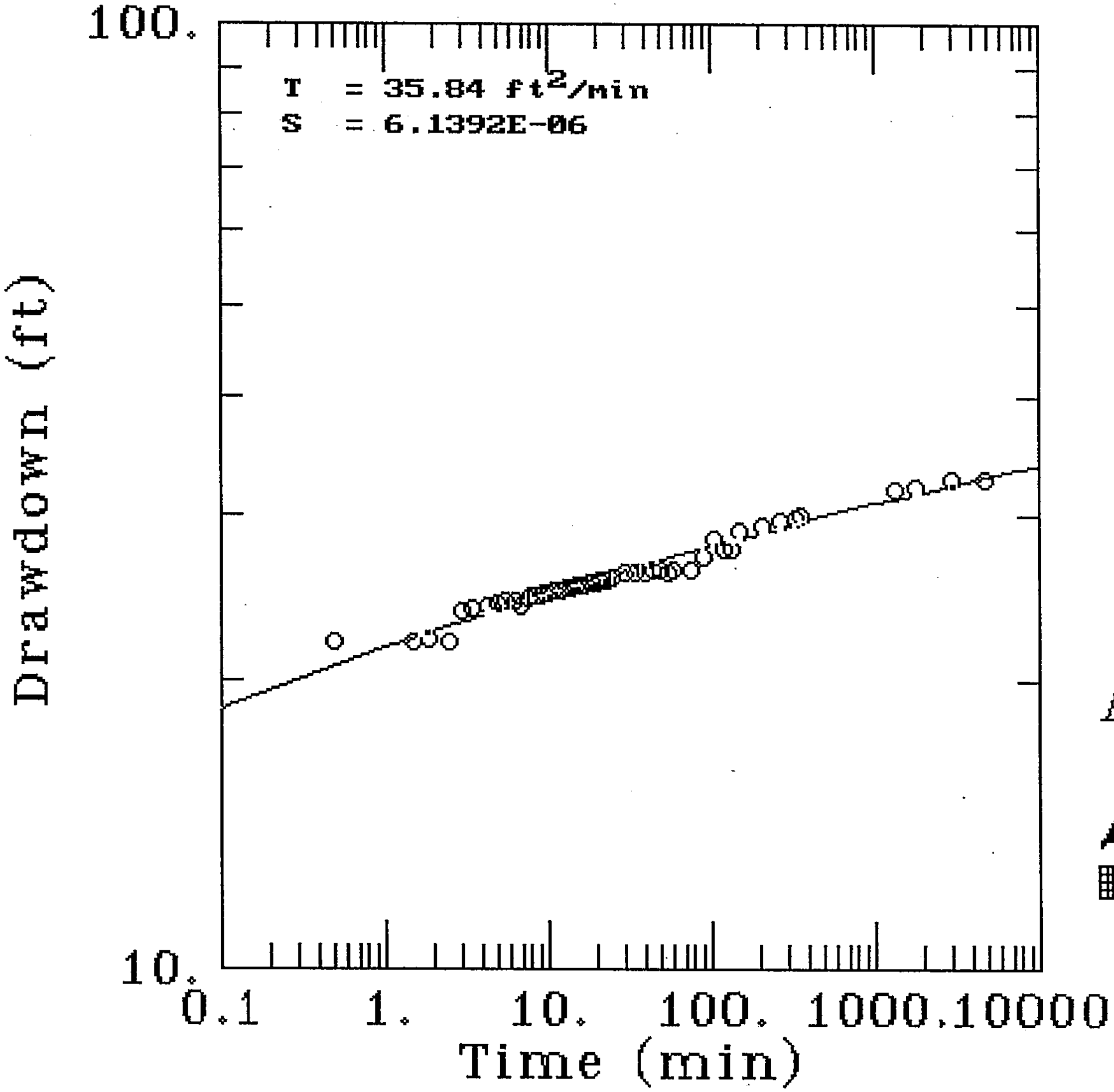
AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

Theis Equation
Well 30G01

20N01W30L01M TEST 2 (PUMPING WELL)



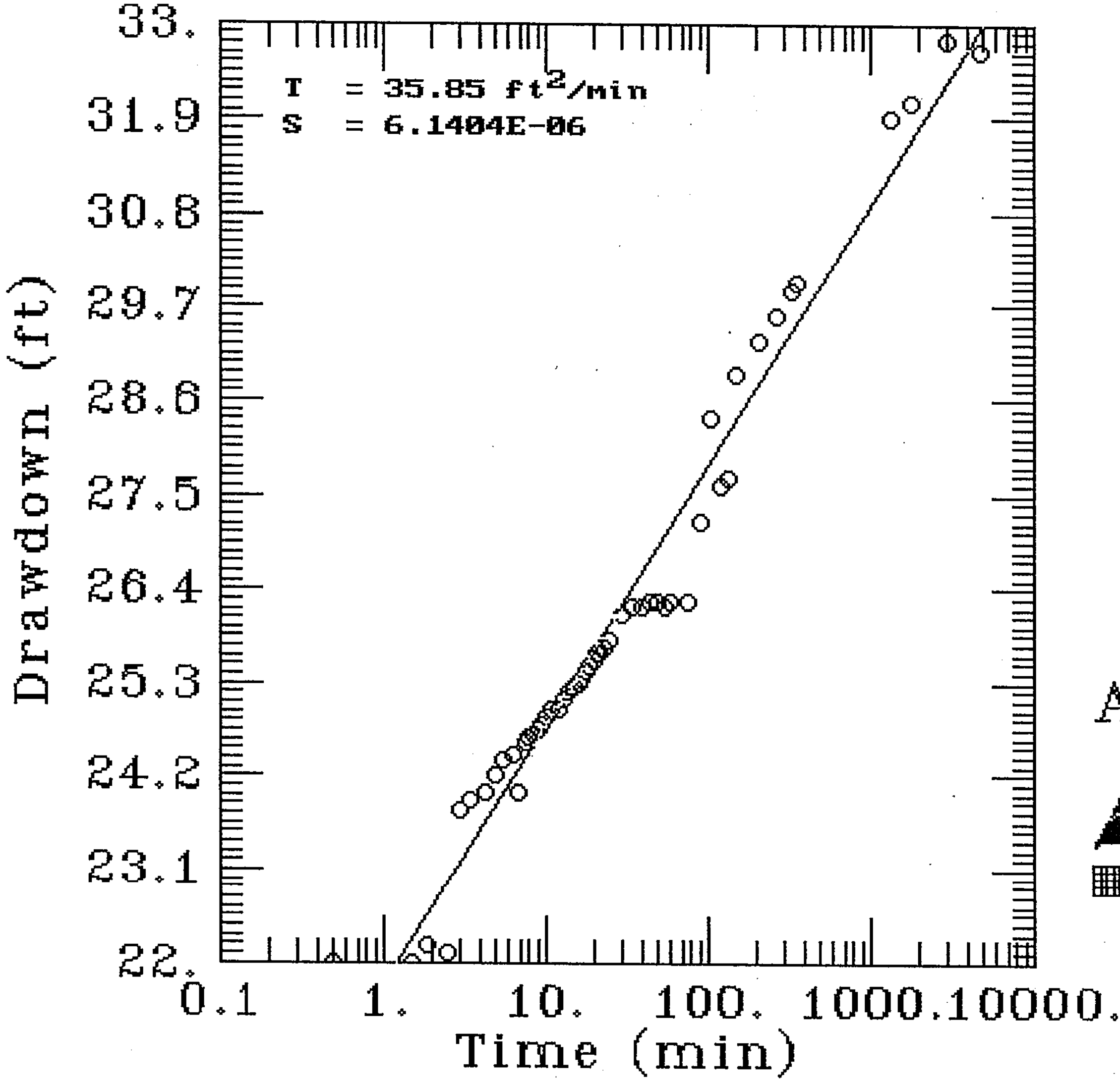
AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

Theis Equation
Provident #4

20N01W30L01M TEST 2 (PUMPING WELL)



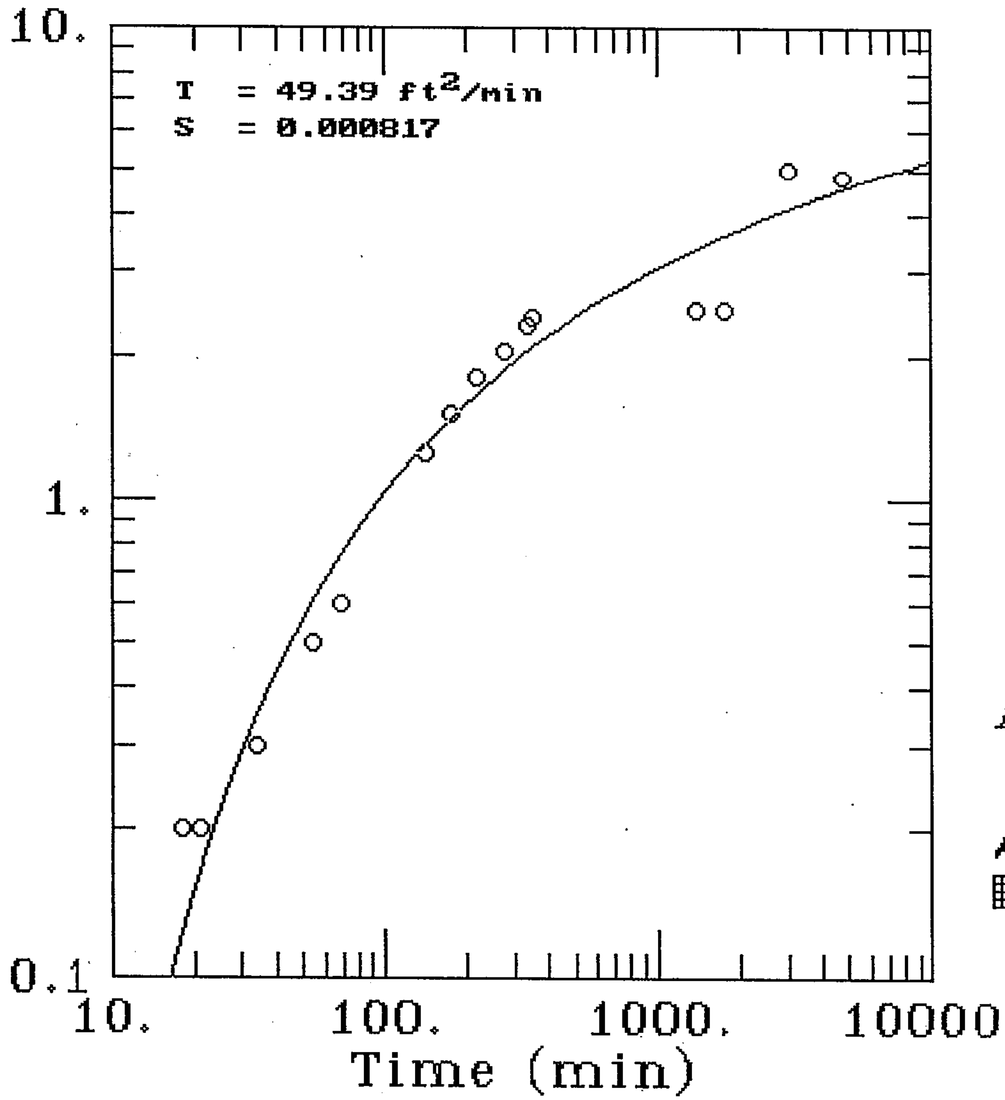
AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

Cooper-Jacob Equation
Provident #4

20N02W25J02M TEST 2 MONITORING WELL



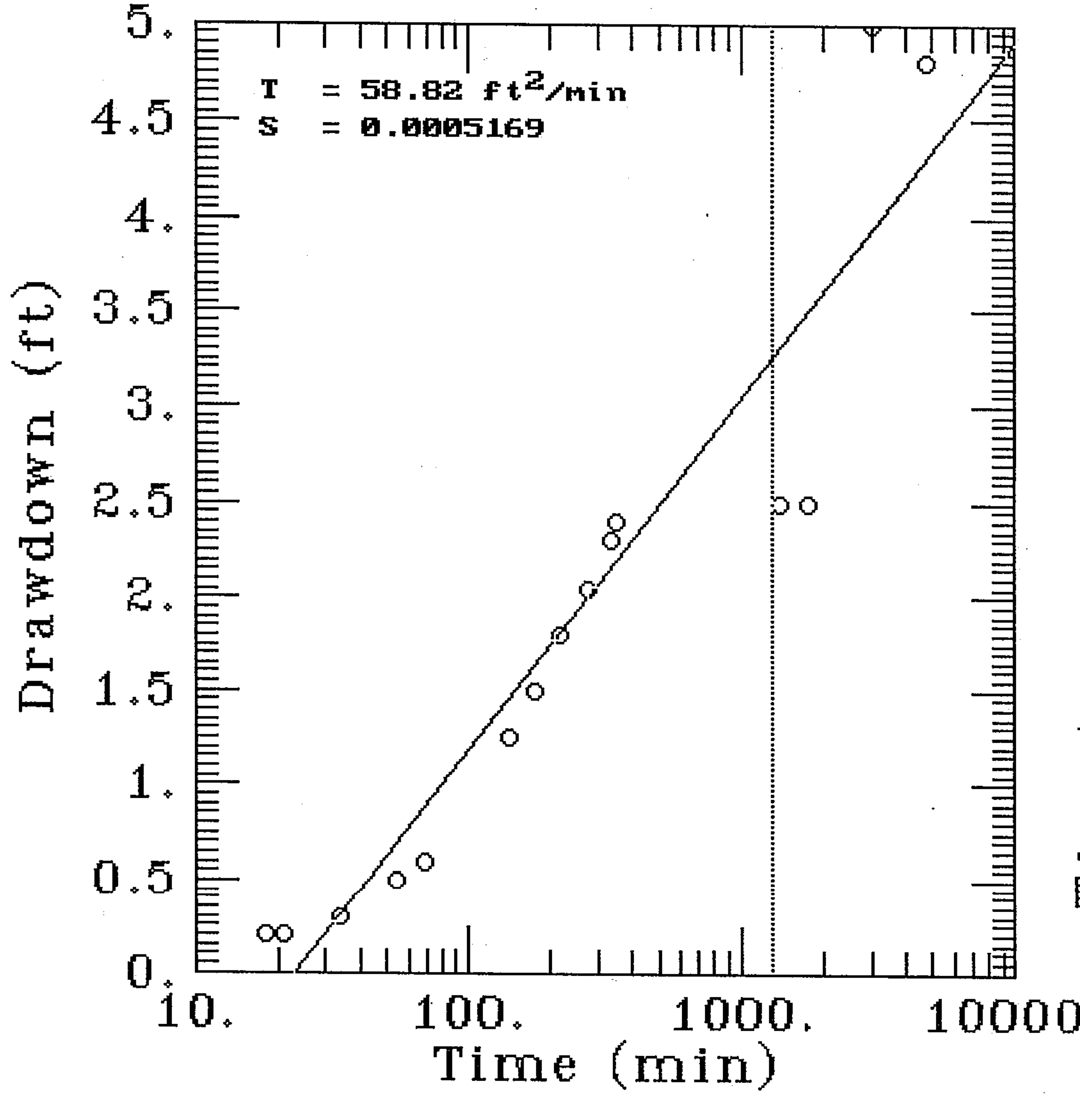
AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

Theis Equation
Well 25J02M

20N02W25J02M TEST 2 MONITORING WELL



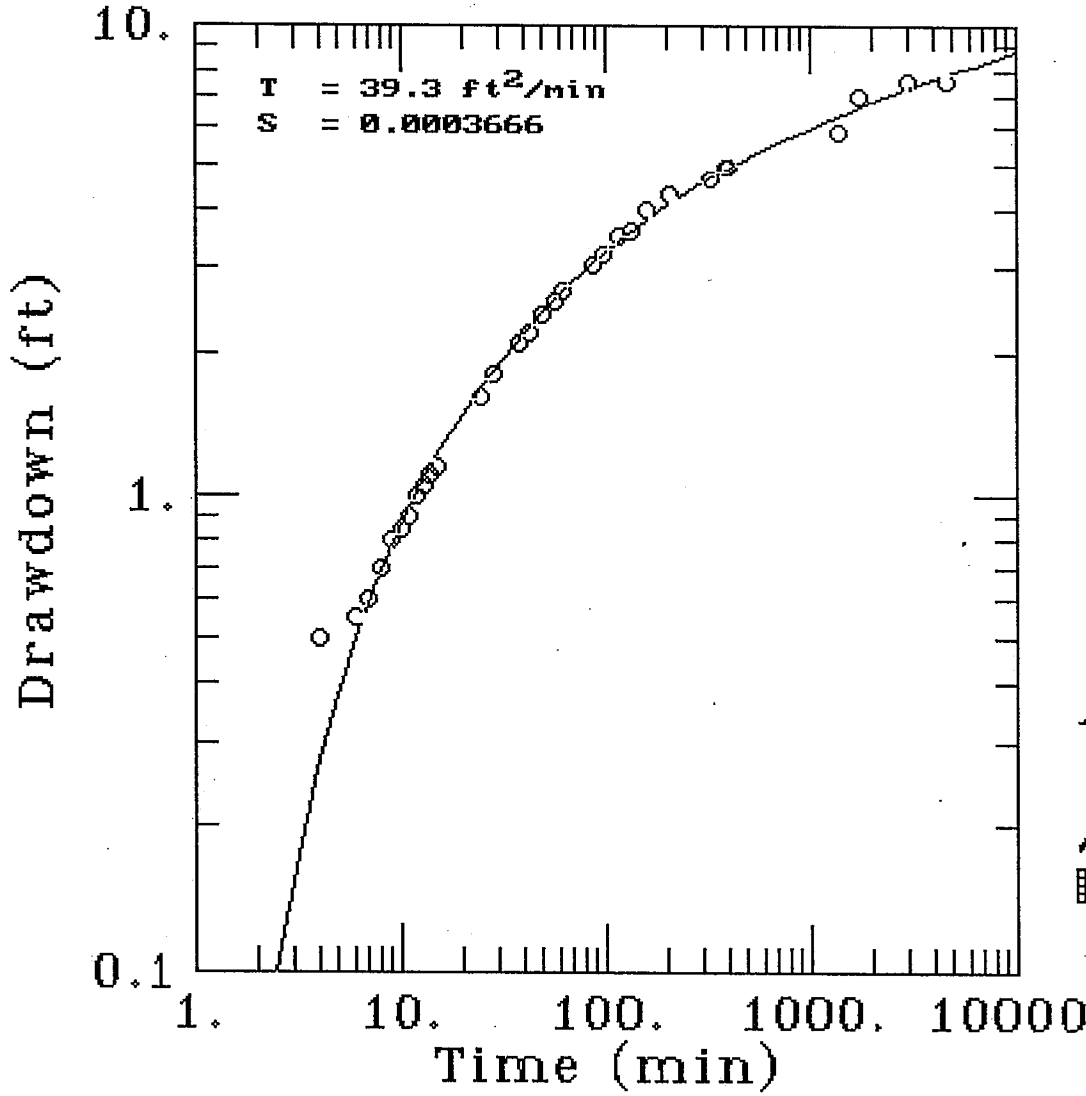
AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

Cooper-Jacob Equation
Well 25J02M

20N02W25J03M TEST 2 MONITORING WELL



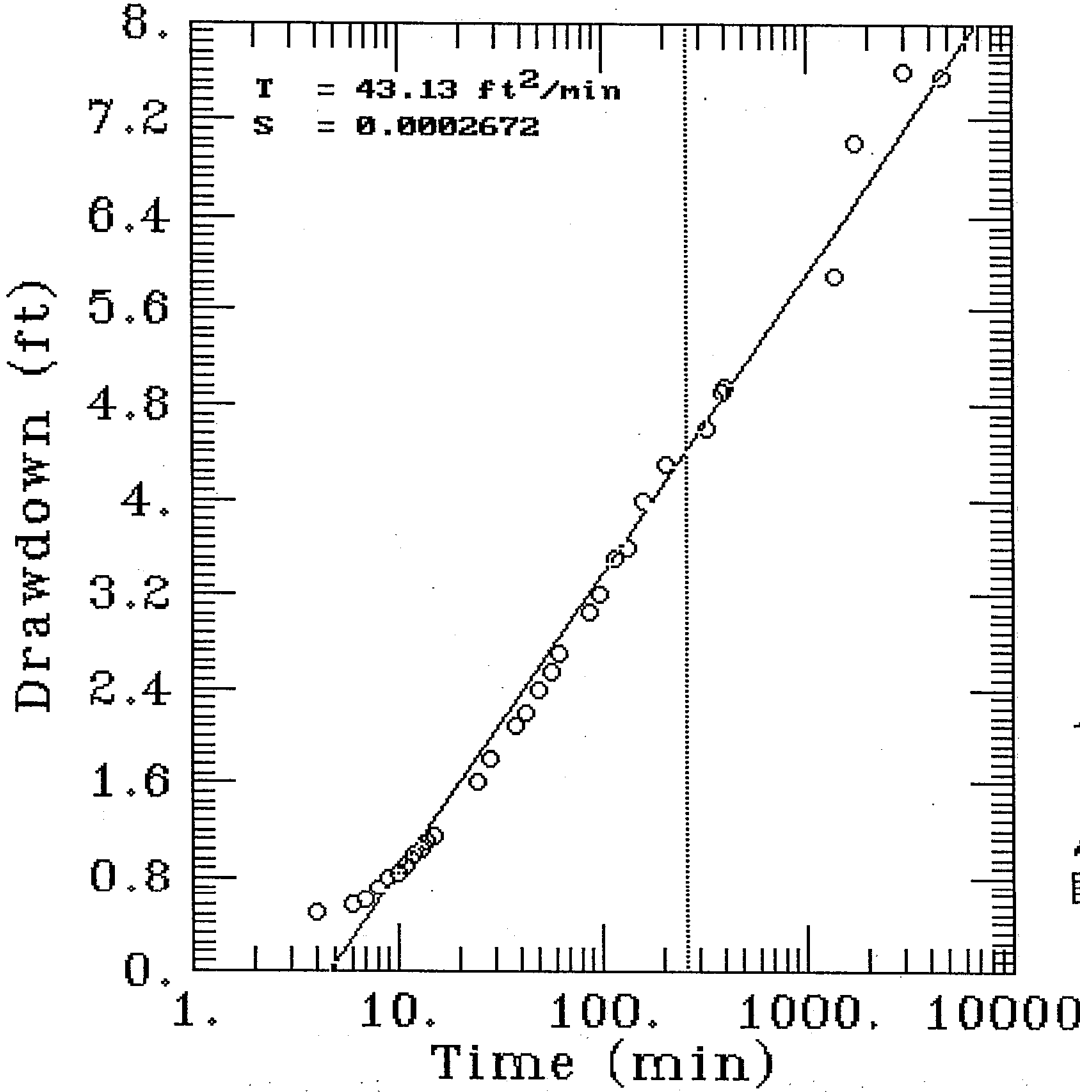
AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

Theis Equation
Provident #3

20N02W25J03M TEST 2 MONITORING WELL



AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Cooper-Jacob Equation
Provident #3

APPENDIX C3
MONITORING DATA

PROVIDENT IRRIGATION DISTRICT

AGENCY	WELL #	RP ELEV	GS ELEV	DATE M	D	Y	NM CODE	QM CODE	TAPE AT RP	TAPE AT WS	RP-WS	GS-WS	WS ELEV	COMMENTS
5050	PID Staff Gage			11	8	95			0.0	83.8	-83.8	-83.8	83.8	
5050	20N01W29M01	102.8	102.1	11	8	95			25.0	4.2	20.8	20.1	82.0	
5050	20N01W29M02	102.6	102.4	11	8	95			22.0	0.6	21.4	21.2	81.2	
5050	20M01W30G01	104.2	103.1	11	8	95			20.0	0.2	19.8	18.7	84.4	
5050	20N01W30H01	102.1	102.1	11	8	95			23.0	3.0	20.0	20.0	82.1	
5050	20N01W30K02	101.5	101.0	11	8	95			24.0	7.2	16.8	16.3	84.7	
5050	20N01W30K03	101.3	101.3											NO DATA UNTIL 12/7
5050	20N01W30L01	100.8	100.4	11	8	95			20.0	6.3	13.7	13.3	87.1	
5050	20N01W25J02	96.9	96.8	11	8	95			20.0	12.8	7.2	7.1	89.7	
5050	20N01W25J03	102.6	102.2	11	8	95			30.0	14.8	15.2	14.8	87.4	
5050	20N01W25L01	100.0	98.2	11	8	95			15.0	10.2	4.8	3.0	95.2	
5050	20N02W27J02	102.9	102.1	11	8	95			20.0	12.7	7.3	6.5	95.6	
5050	PID Staff Gage													NO READING
5050	20N01W29M01	102.8	102.1	11	13	95			21.4	0.0	21.4	20.7	81.4	8:47 AM
5050	20N01W29M02	102.6	102.4	11	13	95			20.6	0.0	20.6	20.4	82.0	
5050	20M01W30G01	104.2	103.1	11	13	95			22.0	0.5	21.5	20.4	82.7	
5050	20N01W30H01	102.1	102.1	11	13	95			21.0	1.2	19.8	19.8	82.3	
5050	20N01W30K02	101.5	101.0	11	13	95			18.4	0.0	18.4	17.9	83.1	
5050	20N01W30K03	101.3	101.3											NO DATA TILL 12/7
5050	20N01W30L01	100.8	100.4	11	13	95			30.0	16.5	13.5	13.1	87.3	
5050	20N01W25J02	96.9	96.8	11	13	95			8.0	0.0	8.0	7.9	88.9	
5050	20N01W25J03	102.6	102.2	11	13	95			15.4	0.0	15.4	15.0	87.2	
5050	20N01W25L01	100.0	98.2	11	13	95			4.3	0.0	4.3	2.5	95.7	
5050	20N02W27J02	102.9	102.1	11	13	95			6.8	0.0	6.8	6.0	96.1	
5050	PID Staff Gage			11	13	95			0.0	83.9	-83.9	-83.9	83.9	12:34 PM
5050	20N01W29M01	102.8	102.1	11	13	95			25.0	3.4	21.6	20.9	81.2	
5050	20N01W29M02	102.6	102.4	11	13	95			23.0	2.3	20.7	20.5	81.9	
5050	20M01W30G01	104.2	103.1	11	13	95			23.0	0.7	22.3	21.2	81.9	
5050	20N01W30H01	102.1	102.1	11	13	95			22.0	1.9	20.1	20.1	82.0	
5050	20N01W30K02	101.5	101.0											NO READING
5050	20N01W30K03	101.3	101.3											NO DATA UNTIL 12/7
5050	20N01W30L01	100.8	100.4											NO READING
5050	20N01W25J02	96.9	96.8											"
5050	20N01W25J03	102.6	102.2											"
5050	20N01W25L01	100.0	97.8											"
5050	20N02W27J02	102.9	102.1											"
5050	PID Staff Gage													NO READING
5050	20N01W29M01	102.8	102.1	11	13	95			22.0	0.4	21.6	20.9	81.2	1:23 PM
5050	20N01W29M02	102.6	102.4	11	13	95			21.0	0.3	20.7	20.5	81.9	
5050	20M01W30G01	104.2	103.1	11	13	95			23.0	0.6	22.4	21.3	81.8	
5050	20N01W30H01	102.1	102.1	11	13	95			22.0	1.9	20.1	20.1	82.0	
5050	20N01W30K02	101.5	101.0											NO READING

PROVIDENT IRRIGATION DISTRICT

AGENCY	WELL #	RP ELEV	GS ELEV	DATE M	D	Y	NM CODE	QM CODE	TAPE AT RP	TAPE AT WS	RP-WS	GS-WS	WS ELEV	COMMENTS
5050	20N01W30K03	101.3	101.3											NO DATA UNTIL 12/7
5050	20N01W30L01	100.8	100.4											NO READING
5050	20N01W25J02	96.9	96.8											"
5050	20N01W25J03	102.6	102.2											"
5050	20N01W25L01	100.0	97.8											"
5050	20N02W27J02	102.9	102.1											"
5050	PID Staff Gage								0.0	83.5				NO READING
5050	20N01W29M01	102.8	102.1	11	13	95			22.0	0.5	21.5	20.8	81.3	2:36 PM
5050	20N01W29M02	102.6	102.4	11	13	95			20.0	-0.7	20.7	20.5	82.0	
5050	20M01W30G01	104.2	103.1											NO READING
5050	20N01W30H01	102.1	102.1	11	13	95			22.0	1.9	20.1	20.1	82.0	
5050	20N01W30K02	101.5	101.0											NO READING
5050	20N01W30K03	101.3	101.3											NO DATA UNTIL 12/7
5050	20N01W30L01	100.8	100.4											NO READING
5050	20N01W25J02	96.9	96.8											"
5050	20N01W25J03	102.6	102.2											"
5050	20N01W25L01	100.0	97.8											"
5050	20N02W27J02	102.9	102.1											"
5050	PID Staff Gage			12	7	95			0.0	84.1	-84.1	-84.1	84.1	
5050	20N01W29M01	102.8	102.1	12	7	95			20.0	-0.9	20.9	20.2	81.9	
5050	20N01W29M02	102.6	102.4											NO DATA
5050	20M01W30G01	104.2	103.1											"
5050	20N01W30H01	102.1	102.1											"
5050	20N01W30K02	101.5	101.0	12	7	95			16.0	-0.7	16.7	16.2	84.8	
5050	20N01W30K03	101.3	101.3	12	7	95			20.0	3.2	16.8	16.8	84.5	
5050	20N01W30L01	100.8	100.4	12	7	95			15.0	1.7	13.3	12.9	87.5	
5050	20N01W25J02	96.9	96.8	12	7	95			7.0	-0.3	7.3	7.2	89.6	
5050	20N01W25J03	102.6	102.2	12	7	95			15.0	0.3	14.7	14.3	87.9	
5050	20N01W25L01	100.0	97.8											NO DATA
5050	20N02W27J02	102.9	102.1											"
5050	PID Staff Gage			1	11	96			0.0	85.0	-85.0	-85.0	85.0	
5050	20N01W29M01	102.8	102.1	1	11	96			20.0	-0.1	20.1	19.4	82.7	
5050	20N01W29M02	102.6	102.4	1	11	96			20.0	0.2	19.8	19.6	82.8	
5050	20M01W30G01	104.2	103.1	1	11	96			20.0	1.3	18.7	17.6	85.5	
5050	20N01W30H01	102.1	102.1	1	11	96			20.0	2.0	18.0	18.0	84.1	
5050	20N01W30K02	101.5	101.0	1	11	96			16.0	0.2	15.8	15.3	85.7	
5050	20N01W30K03	101.3	101.3	1	11	96			17.0	1.2	15.8	15.8	85.5	
5050	20N01W30L01	100.8	100.4	1	11	96			12.0	0.1	11.9	11.5	88.9	
5050	20N01W25J02	96.9	96.8	1	11	96			6.0	0.2	5.8	5.7	91.1	
5050	20N01W25J03	102.6	102.2	1	11	96			14.0	1.0	13.0	12.6	89.6	
5050	20N01W25L01	100.0	98.2	1	11	96			9.0	5.7	3.3	1.5	96.7	
5050	20N02W27J02	102.9	102.1	1	11	96			10.0	4.0	6.0	5.2	96.9	

PROVIDENT IRRIGATION DISTRICT

AGENCY	WELL #	RP ELEV	GS ELEV	DATE M	D	Y	NM CODE	QM CODE	TAPE AT RP	TAPE AT WS	RP-WS	GS-WS	WS ELEV	COMMENTS
5050	PID Staff Gage			1	26	96			0.0	89.4	-89.4	-89.4	89.4	
5050	20N01W29M01	102.8	102.1	1	26	96			20.0	4.5	15.5	14.8	87.3	
5050	20N01W29M02	102.6	102.4	1	26	96			20.0	5.3	14.7	14.5	87.9	
5050	20M01W30G01	104.2	103.1	1	26	96			11.0	0.5	10.5	9.4	93.7	
5050	20N01W30H01	102.1	102.1	1	26	96			16.0	2.3	13.7	13.7	88.4	
5050	20N01W30K02	101.5	101.0	1	26	96			12.0	0.2	11.8	11.3	89.7	
5050	20N01W30K03	101.3	101.3	1	26	96			12.0	0.1	11.9	11.9	89.4	
5050	20N01W30L01	100.8	100.4	1	26	96			9.0	0.0	9.0	8.6	91.8	SOUNDER
5050	20N01W25J02	96.9	96.8	1	26	96			9.0	5.9	3.1	3.0	93.8	
5050	20N01W25J03	102.6	102.2	1	26	96			13.0	2.9	10.1	9.7	92.5	
5050	20N01W25L01	100.0	98.2	1	26	96			5.0	3.0	2.0	0.2	98.0	
5050	20N02W27J02	102.9	102.1	1	26	96			2.3	0.0	2.3	1.5	100.6	SOUNDER
5050	PID Staff Gage			2	1	96			0.0	91.2	-91.2	-91.2	91.2	7:30 AM
5050	20N01W29M01	102.8	102.1	2	1	96			13.0	-0.6	13.6	12.9	89.2	
5050	20N01W29M02	102.6	102.4	2	1	96			14.0	1.2	12.8	12.6	89.8	
5050	20M01W30G01	104.2	103.1	2	1	96		4	15.0	2.2	12.8	11.7	91.4	
5050	20N01W30H01	102.1	102.1	2	1	96			12.0	0.2	11.8	11.8	90.3	
5050	20N01W30K02	101.5	101.0	2	1	96			11.0	0.6	10.4	9.9	91.1	
5050	20N01W30K03	101.3	101.3	2	1	96			11.0	0.8	10.2	10.2	91.1	
5050	20N01W30L01	100.8	100.4	2	1	96			7.7	0.0	7.7	7.3	93.1	SOUNDER
5050	20N01W25J02	96.9	96.8	2	1	96			8.0	5.9	2.1	2.0	94.8	
5050	20N01W25J03	102.6	102.2	2	1	96			10.0	1.1	8.9	8.5	93.7	
5050	20N01W25L01	100.0	97.8	2	1	96			1.2	0.0	1.2	-1.0	98.8	
5050	20N02W27J02	102.9	102.1	2	1	96			4.3	0.0	4.3	3.5	98.6	NEARBY DITCH FLOWING
5050	PID Staff Gage			2	1	96				90.8	-90.8	-90.8	90.8	4 PM reading
5050	20N01W29M01	102.8	102.1	2	1	96			12.9		12.9	12.2	89.9	
5050	20N01W29M02	102.6	102.4	2	1	96			13.1		13.1	12.9	89.5	Greyed cells are pump test data
5050	20M01W30G01	104.2	103.1	2	1	96			13.2		13.2	12.1	91.1	
5050	20N01W30H01	102.1	102.1	2	1	96			12.4		12.4	12.4	89.7	
5050	20N01W30K02	101.5	101.0	2	1	96			11.5		11.5	11.0	90.1	
5050	20N01W30K03	101.3	101.3	2	1	96			11.8		11.8	11.8	89.6	
5050	20N01W30L01	100.8	100.4	2	1	96			37.7		37.7	37.3	63.1	
5050	20N01W25J02	96.9	96.8	2	1	96			4.4		4.4	4.3	92.5	
5050	20N01W25J03	102.6	102.2	2	1	96			13.5		13.5	13.1	89.2	
5050	20N01W25L01	100.0	97.8	2	1	96			-0.8		-0.8	-3.0	100.8	
5050	20N02W27J02	102.9	102.1	2	1	96			3.5		3.5	2.7	99.4	
5050	PID Staff Gage			2	2	96				90.1	-90.1	-90.1	90.1	7:20 AM reading
5050	20N01W29M01	102.8	102.1	2	2	96			14.2		14.2	13.5	88.6	
5050	20N01W29M02	102.6	102.4	2	2	96			13.8		13.8	13.6	88.8	
5050	20M01W30G01	104.2	103.1	2	2	96			14.0		14.0	12.9	90.2	
5050	20N01W30H01	102.1	102.1	2	2	96			13.1		13.1	13.1	89.0	
5050	20N01W30K02	101.5	101.0	2	2	96			12.4		12.4	11.9	89.1	

PROVIDENT IRRIGATION DISTRICT

AGENCY	WELL #	RP ELEV	GS ELEV	DATE M	D	Y	NM CODE	QM CODE	TAPE AT RP	TAPE AT WS	RP-WS	GS-WS	WS ELEV	COMMENTS
5050	20N01W30K03	101.3	101.3	2	2	96			12.8		12.8	12.8	88.5	
5050	20N01W30L01	100.8	100.4	2	2	96			39.5		39.5	39.1	61.3	
5050	20N01W25J02	96.9	96.8	2	2	96			6.1		6.1	6.0	90.8	
5050	20N01W25J03	102.6	102.2	2	2	96			14.4		14.4	14.0	88.2	
5050	20N01W25L01	100.0	97.8	2	2	96			-0.3		-0.3	-2.5	100.3	
5050	20N02W27J02	102.9	102.1	2	2	96			3.7		3.7	2.9	99.2	
5050	PID Staff Gage			2	2	96				89.9	-89.9	-89.9	89.9	2:20 PM reading
5050	20N01W29M01	102.8	102.1	2	2	96			14.4		14.4	13.7	88.4	
5050	20N01W29M02	102.6	102.4	2	2	96			14.0		14.0	13.8	88.6	
5050	20M01W30G01	104.2	103.1	2	2	96			14.3		14.3	13.2	89.9	
5050	20N01W30H01	102.1	102.1	2	2	96			13.5		13.5	13.5	88.6	
5050	20N01W30K02	101.5	101.0	2	2	96			12.4		12.4	11.9	89.1	
5050	20N01W30K03	101.3	101.3	2	2	96			13.1		13.1	13.1	88.2	
5050	20N01W30L01	100.8	100.4	2	2	96			39.8		39.8	39.4	61.0	
5050	20N01W25J02	96.9	96.8	2	2	96			4.5		4.5	4.4	92.4	
5050	20N01W25J03	102.6	102.2	2	2	96			15.5		15.5	15.1	87.1	
5050	20N01W25L01	100.0	97.8	2	2	96			-0.3		-0.3	-2.5	100.3	
5050	20N02W27J02	102.9	102.1	2	2	96			5.6		5.6	4.8	97.3	
5050	PID Staff Gage			2	3	96				88.9	-88.9	-88.9	88.9	10:58 AM reading
5050	20N01W29M01	102.8	102.1	2	3	96			15.4		15.4	14.7	87.4	
5050	20N01W29M02	102.6	102.4	2	3	96			15.0		15.0	14.8	87.6	
5050	20M01W30G01	104.2	103.1	2	3	96			15.0		15.0	13.9	89.2	
5050	20N01W30H01	102.1	102.1	2	3	96			14.3		14.3	14.3	87.8	
5050	20N01W30K02	101.5	101.0	2	3	96			13.3		13.3	12.8	88.2	
5050	20N01W30K03	101.3	101.3	2	3	96			13.6		13.6	13.6	87.7	
5050	20N01W30L01	100.8	100.4	2	3	96			40.5		40.5	40.1	60.3	
5050	20N01W25J02	96.9	96.8	2	3	96			7.0		7.0	6.9	89.9	
5050	20N01W25J03	102.6	102.2	2	3	96			16.1		16.1	15.7	86.5	
5050	20N01W25L01	100.0	98.2	2	3	96			0.1		0.1	-1.7	99.9	
5050	20N02W27J02	102.9	102.1	2	3	96			4.0		4.0	3.2	98.9	
5050	PID Staff Gage			2	4	96				91.6	-91.6	-91.6	91.6	3:04 PM reading
5050	20N01W29M01	102.8	102.1	2	4	96			13.3		13.3	12.6	89.5	
5050	20N01W29M02	102.6	102.4	2	4	96			13.0		13.0	12.8	89.6	
5050	20M01W30G01	104.2	103.1	2	4	96			11.7		11.7	10.6	92.5	
5050	20N01W30H01	102.1	102.1	2	4	96			14.9		14.9	14.9	87.2	
5050	20N01W30K02	101.5	101.0	2	4	96			12.3		12.3	11.8	89.2	
5050	20N01W30K03	101.3	101.3	2	4	96			12.6		12.6	12.6	88.7	
5050	20N01W30L01	100.8	100.4	2	4	96			40.4		40.4	40.0	60.4	
5050	20N01W25J02	96.9	96.8	2	4	96			6.8		6.8	6.7	90.1	
5050	20N01W25J03	102.6	102.2	2	4	96			16.1		16.1	15.7	86.6	
5050	20N01W25L01	100.0	98.2	2	4	96			-0.4		-0.4	-2.2	100.4	
5050	20N02W27J02	102.9	102.1	2	4	96			3.2		3.2	2.4	99.7	

PROVIDENT IRRIGATION DISTRICT

AGENCY	WELL #	RP ELEV	GS ELEV	DATE M	DATE D	DATE Y	NM CODE	QM CODE	TAPE AT RP	TAPE AT WS	RP-WS	GS-WS	WS ELEV	COMMENTS
5050	PID Staff Gage			2	5	96				100.2	-100.2	-100.2	100.2	12:50 PM reading
5050	20N01W29M01	102.8	102.1	2	5	96			5.7		5.7	5.0	97.1	
5050	20N01W29M02	102.6	102.4	2	5	96			5.7		5.7	5.5	96.9	
5050	20M01W30G01	104.2	103.1	2	5	96			7.9		7.9	6.8	96.3	
5050	20N01W30H01	102.1	102.1	2	5	96			6.7		6.7	6.7	95.4	
5050	20N01W30K02	101.5	101.0	2	5	96			6.2		6.2	5.7	95.3	
5050	20N01W30K03	101.3	101.3	2	5	96			6.5		6.5	6.5	94.8	
5050	20N01W30L01	100.8	100.4	2	5	96			6.2		6.2	5.8	94.6	
5050	20N01W25J02	96.9	96.8	2	5	96			1.5		1.5	1.4	95.4	
5050	20N01W25J03	102.6	102.2	2	5	96			6.5		6.5	6.1	96.1	
5050	20N01W25L01	100.0	97.8	2	5	96			-1.6		-1.6	-3.8	101.6	
5050	20N02W27J02	102.9	102.1	2	5	96			2.8		2.8	2.0	100.1	
5050	PID Staff Gage			2	7	96				93.5	-93.5	-93.5	93.5	1:30 PM reading
5050	20N01W29M01	102.8	102.1	2	7	96			10.3		10.3	9.6	92.5	
5050	20N01W29M02	102.6	102.4	2	7	96			9.7		9.7	9.5	92.9	
5050	20M01W30G01	104.2	103.1	2	7	96			9.2		9.2	8.1	95.0	
5050	20N01W30H01	102.1	102.1	2	7	96			8.9		8.9	8.9	93.2	
5050	20N01W30K02	101.5	101.0	2	7	96			7.4		7.4	6.9	94.1	
5050	20N01W30K03	101.3	101.3	2	7	96			7.7		7.7	7.7	93.6	
5050	20N01W30L01	100.8	100.4	2	7	96			5.6		5.6	5.2	95.2	
5050	20N01W25J02	96.9	96.8	2	7	96			0.3		0.3	0.2	96.6	
5050	20N01W25J03	102.6	102.2	2	7	96			6.7		6.7	6.3	95.9	
5050	20N01W25L01	100.0	97.8	2	7	96			-2.0		-2.0	-4.2	102.0	
5050	20N02W27J02	102.9	102.1	2	7	96			2.8		2.8	2.0	100.1	
5050	PID Staff Gage			2	10	96			0.0	90.1	-90.1	-90.1	90.1	
5050	20N01W29M01	102.8	102.1	2	10	96			16.0	-0.1	16.1	15.4	86.7	
5050	20N01W29M02	102.6	102.4	2	10	96			14.0	0.5	13.5	13.3	89.1	
5050	20M01W30G01	104.2	103.1	2	10	96			13.0	0.0	13.0	11.9	91.2	
5050	20N01W30H01	102.1	102.1	2	10	96			13.0	0.9	12.1	12.1	90.0	
5050	20N01W30K02	101.5	101.0	2	10	96			11.0	0.7	10.3	9.8	91.2	
5050	20N01W30K03	101.3	101.3	2	10	96			10.0	0.2	9.8	9.8	91.5	
5050	20N01W30L01	100.8	100.4	2	10	96			8.0	-0.2	8.2	7.8	92.6	
5050	20N01W25J02	96.9	96.8	2	10	96			3.0	1.5	1.5	1.4	95.4	
5050	20N01W25J03	102.6	102.2	2	10	96			10.0	1.6	8.4	8.0	94.2	
5050	20N01W25L01	100.0	97.8	2	10	96			2.0	1.2	0.8	-1.4	99.2	
5050	20N02W27J02	102.9	102.1	2	10	96			5.0	1.1	3.9	3.1	99.0	
5050	PID Staff Gage			3	13	96			0.0	93.8	-93.8	-93.8	93.8	
5050	20N01W29M01	102.8	102.1	3	13	96			12.0	1.3	10.7	10.0	92.1	
5050	20N01W29M02	102.6	102.4	3	13	96			10.0	0.1	9.9	9.7	92.7	
5050	20M01W30G01	104.2	103.1	3	13	96			12.0	1.9	10.1	9.0	94.1	
5050	20N01W30H01	102.1	102.1	3	13	96			11.0	2.1	8.9	8.9	93.2	
5050	20N01W30K02	101.5	101.0	3	13	96			8.0	0.4	7.6	7.1	93.9	

PROVIDENT IRRIGATION DISTRICT

AGENCY	WELL #	RP ELEV	GS ELEV	DATE M	D	Y	NM CODE	QM CODE	TAPE AT RP	TAPE AT WS	RP-WS	GS-WS	WS ELEV	COMMENTS
5050	20N01W30K03	101.3	101.3	3	13	96			9.0	1.6	7.4	7.4	93.9	
5050	20N01W30L01	100.8	100.4	3	13	96			8.0	2.2	5.8	5.4	95.0	
5050	20N01W25J02	96.9	96.8											NO DATA
5050	20N01W25J03	102.6	102.2	3	13	96			8.0	1.5	6.5	6.1	96.1	
5050	20N01W25L01	100.0	97.8	3	13	96			0.0	0.3	-0.3	-2.5	100.3	
5050	20N02W27J02	102.9	102.1	3	13	96			6.0	2.2	3.8	3.0	99.1	
5050	PID Staff Gage			3	27	96			0.0	86.3	-86.3	-86.3	86.3	
5050	20N01W29M01	102.8	102.1	3	27	96			18.4	0.0	18.4	17.7	84.4	
5050	20N01W29M02	102.6	102.4	3	27	96			17.9	0.0	17.9	17.7	84.7	
5050	20M01W30G01	104.2	103.1	3	27	96			16.0	-0.6	16.6	15.5	87.6	
5050	20N01W30H01	102.1	102.1	3	27	96			20.0	4.0	16.0	16.0	86.1	
5050	20N01W30K02	101.5	101.0	3	27	96			14.0	0.2	13.8	13.3	87.7	
5050	20N01W30K03	101.3	101.3	3	27	96			15.0	1.4	13.6	13.6	87.7	
5050	20N01W30L01	100.8	100.4	3	27	96			10.0	-0.2	10.2	9.8	90.6	
5050	20N01W25J02	96.9	96.8	3	27	96			7.0	3.3	3.7	3.6	93.2	
5050	20N01W25J03	102.6	102.2	3	27	96			12.0	1.2	10.8	10.4	91.8	
5050	20N01W25L01	100.0	97.8	3	27	96			2.6	0.0	2.6	0.4	97.4	
5050	20N02W27J02	102.9	102.1	3	27	96			5.4	0.0	5.4	4.6	97.5	
5050	PID Staff Gage			4	10	96			0.0	86.0	-86.0	-86.0	86.0	
5050	20N01W29M01	102.8	102.1	4	10	96			19.0	0.1	18.9	18.2	83.9	
5050	20N01W29M02	102.6	102.4	4	10	96			18.0	0.0	18.0	17.8	84.6	
5050	20M01W30G01	104.2	103.1	4	10	96			17.0	-0.5	17.5	16.4	86.7	
5050	20N01W30H01	102.1	102.1	4	10	96			17.0	0.2	16.8	16.8	85.3	
5050	20N01W30K02	101.5	101.0	4	10	96			14.0	-0.8	14.8	14.3	86.7	
5050	20N01W30K03	101.3	101.3	4	10	96			14.0	-0.5	14.5	14.5	86.8	
5050	20N01W30L01	100.8	100.4	4	10	96			12.0	0.8	11.2	10.8	89.6	
5050	20N01W25J02	96.9	96.8	4	10	96			4.0	-0.6	4.6	4.5	92.3	
5050	20N01W25J03	102.6	102.2	4	10	96			11.0	-0.9	11.9	11.5	90.7	
5050	20N01W25L01	100.0	97.8	4	10	96			3.0	0.0	3.0	0.8	97.0	
5050	20N02W27J02	102.9	102.1	4	10	96			8.0	2.2	5.8	5.0	97.1	
5050	PID Staff Gage			4	29	96		1	0.0	85.7	-85.7	-85.7	85.7	PUMPING ~50CFS
5050	20N01W29M01	102.8	102.1	4	29	96		1	55.0	11.7	43.3	42.6	59.5	
5050	20N01W29M02	102.6	102.4	4	29	96		2	21.0	0.7	20.3	20.1	82.3	
5050	20M01W30G01	104.2	103.1	4	29	96			23.0	-0.3	23.3	22.2	80.9	
5050	20N01W30H01	102.1	102.1	4	29	96		2	20.0	0.3	19.7	19.7	82.4	
5050	20N01W30K02	101.5	101.0	4	29	96		1	60.0	24.5	35.5	35.0	66.0	FLOODING FIELDS
5050	20N01W30K03	101.3	101.3	4	29	96		2	30.0	4.2	25.8	25.8	75.5	
5050	20N01W30L01	100.8	100.4	4	29	96		1	40.7	0.0	40.7	40.3	60.1	SOUNDER
5050	20N01W25J02	96.9	96.8	4	29	96			12.0	0.9	11.1	11.0	85.8	
5050	20N01W25J03	102.6	102.2	4	29	96		2	23.0	1.0	22.0	21.6	80.6	
5050	20N01W25L01	100.0	97.8	4	29	96			6.0	0.8	5.2	3.0	94.8	
5050	20N02W27J02	102.9	102.1	4	29	96			10.0	3.2	6.8	6.0	96.1	

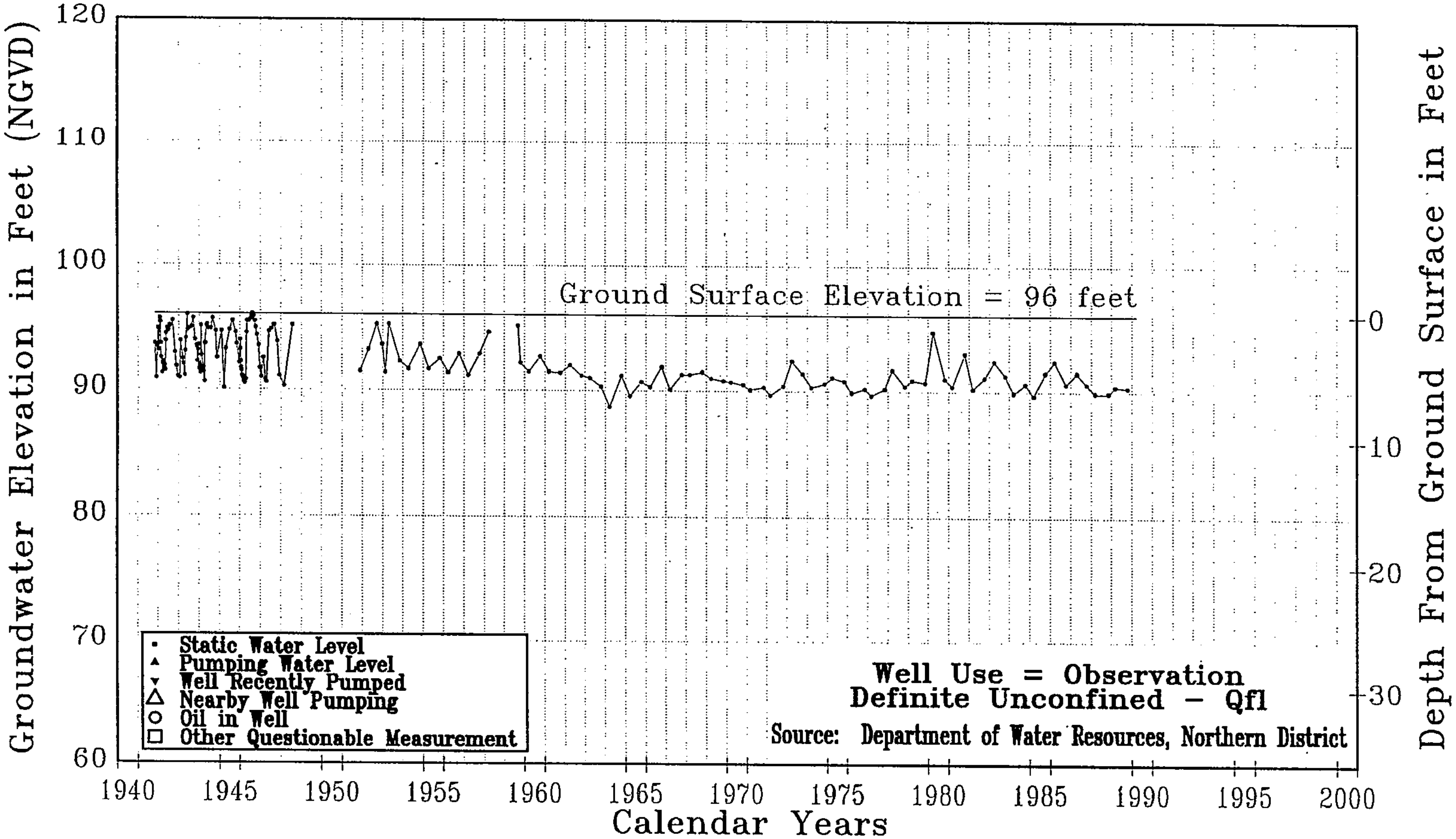
PROVIDENT IRRIGATION DISTRICT

AGENCY	WELL #	RP ELEV	GS ELEV	DATE M	D	Y	NM CODE	QM CODE	TAPE AT RP	TAPE AT WS	RP-WS	GS-WS	WS ELEV	COMMENTS
5050	PID Staff Gage			6	11	96		1	0.0	86.7	-86.7	-86.7	86.7	
5050	20N01W29M01	102.8	102.1	6	11	96		1	50.0	4.6	45.4	44.7	57.4	
5050	20N01W29M02	102.6	102.4	6	11	96			25.0	5.3	19.7	19.5	82.9	
5050	20M01W30G01	104.2	103.1	6	11	96			25.0	4.8	20.2	19.1	84.0	
5050	20N01W30H01	102.1	102.1	6	11	96			25.0	7.4	17.6	17.6	84.5	
5050	20N01W30K02	101.5	101.0	6	11	96	7							WELL HOUSE FLOODED
5050	20N01W30K03	101.3	101.3	6	11	96		2	30.0	4.1	25.9	25.9	75.4	
5050	20N01W30L01	100.8	100.4	6	11	96			15.0	1.9	13.1	12.7	87.7	
5050	20N01W25J02	96.9	96.8	6	11	96			6.0	3.9	2.1	2.0	94.8	PUMP GONE, RP=CONC. PAD
5050	20N01W25J03	102.6	102.2	6	11	96			15.0	1.8	13.2	12.8	89.4	
5050	20N01W25L01	100.0	97.8	6	11	96			6.0	2.6	3.4	1.2	96.6	
5050	20N02W27J02	102.9	102.1	6	11	96			8.0	2.2	5.8	5.0	97.1	
5050	PID Staff Gage			7	18	96			0.0	86.8	-86.8	-86.8	86.8	PUMPING
5050	20N01W29M01	102.8	102.1	7	18	96		1	105.0	60.0	45.0	44.3	57.8	
5050	20N01W29M02	102.6	102.4	7	18	96			21.0	1.0	20.0	19.8	82.6	
5050	20M01W30G01	104.2	103.1	7	18	96			25.0	3.7	21.3	20.2	82.9	
5050	20N01W30H01	102.1	102.1	7	18	96		1	25.0	6.4	18.6	18.6	83.5	
5050	20N01W30K02	101.5	101.0	7	18	96	7							CASCADING WATER
5050	20N01W30K03	101.3	101.3	7	18	96			83.3	60.0	23.3	23.3	78.0	
5050	20N01W30L01	100.8	100.4	7	18	96			15.0	1.0	14.0	13.6	86.8	
5050	20N01W25J02	96.9	96.8	7	18	96			5.0	3.3	1.7	1.6	95.2	
5050	20N01W25J03	102.6	102.2	7	18	96			15.0	0.5	14.5	14.1	88.1	
5050	20N01W25L01	100.0	97.8	7	18	96			7.0	1.8	5.2	3.0	94.8	
5050	20N02W27J02	102.9	102.1	7	18	96			10.0	2.0	8.0	7.2	94.9	
5050	20N02W33M01	104.0	106.2	7	18	96		8	9.0	3.6	5.4	7.6	98.6	
5050	PID Staff Gage			8	9	96			0.0	86.1	-86.1	-86.1	86.1	PUMPING
5050	20N01W29M01	102.8	102.1	8	9	96	1							
5050	20N01W29M02	102.6	102.4	8	9	96			55.0	33.6	21.4	21.2	81.2	
5050	20M01W30G01	104.2	103.1	8	9	96			25.0	7.6	17.4	16.3	86.8	
5050	20N01W30H01	102.1	102.1	8	9	96			25.0	9.6	15.4	15.4	86.7	
5050	20N01W30K02	101.5	101.0	8	9	96	7							WASPS!!
5050	20N01W30K03	101.3	101.3	8	9	96			45.0	28.5	16.5	16.5	84.8	
5050	20N01W30L01	100.8	100.4	8	9	96			15.0	2.1	12.9	12.5	87.9	
5050	20N01W25J02	96.9	96.8	8	9	96			6.0	1.5	4.5	4.4	92.4	
5050	20N01W25J03	102.6	102.2	8	9	96			14.0	1.4	12.6	12.2	90.0	
5050	20N01W25L01	100.0	97.8	8	9	96			15.0	9.2	5.8	3.6	94.2	
5050	20N02W27J02	102.9	102.1	8	9	96			10.0	3.0	7.0	6.2	95.9	
5050	20N02W33M01	104.0	106.2	8	9	96		8	9.0	4.3	4.7	6.9	99.3	
5050	PID Staff Gage			9	4	96			0.0	85.7	-85.7	-85.7	85.7	
5050	20N01W29M01	102.8	102.1	9	4	96			24.0	4.8	19.2	18.5	83.6	
5050	20N01W29M02	102.6	102.4	9	4	96			20.0	1.5	18.5	18.3	84.1	
5050	20M01W30G01	104.2	103.1	9	4	96			17.0	-0.1	17.1	16.0	87.1	

PROVIDENT IRRIGATION DISTRICT

AGENCY	WELL #	RP ELEV	GS ELEV	DATE M	D	Y	NM CODE	QM CODE	TAPE AT RP	TAPE AT WS	RP-WS	GS-WS	WS ELEV	COMMENTS
5050	20N01W30H01	102.1	102.1	9	4	96			16.0	-0.5	16.5	16.5	85.6	
5050	20N01W30K02	101.5	101.0	9	4	96			15.0	0.6	14.4	13.9	87.1	
5050	20N01W30K03	101.3	101.3	9	4	96			14.0	-0.2	14.2	14.2	87.1	
5050	20N01W30L01	100.8	100.4	9	4	96			12.0	0.1	11.9	11.5	88.9	
5050	20N01W25J02	96.9	96.8	9	4	96			8.0	2.0	6.0	5.9	90.9	
5050	20N01W25J03	102.6	102.2	9	4	96			14.0	1.4	12.6	12.2	90.0	
5050	20N01W25L01	100.0	97.8	9	4	96			4.0	1.8	2.2	0.0	97.8	
5050	20N02W27J02	102.9	102.1	9	4	96			7.0	2.1	4.9	4.1	98.0	
5050	20N02W33M01	104.0	106.2	9	4	96		8	5.0	0.8	4.2	6.4	99.8	

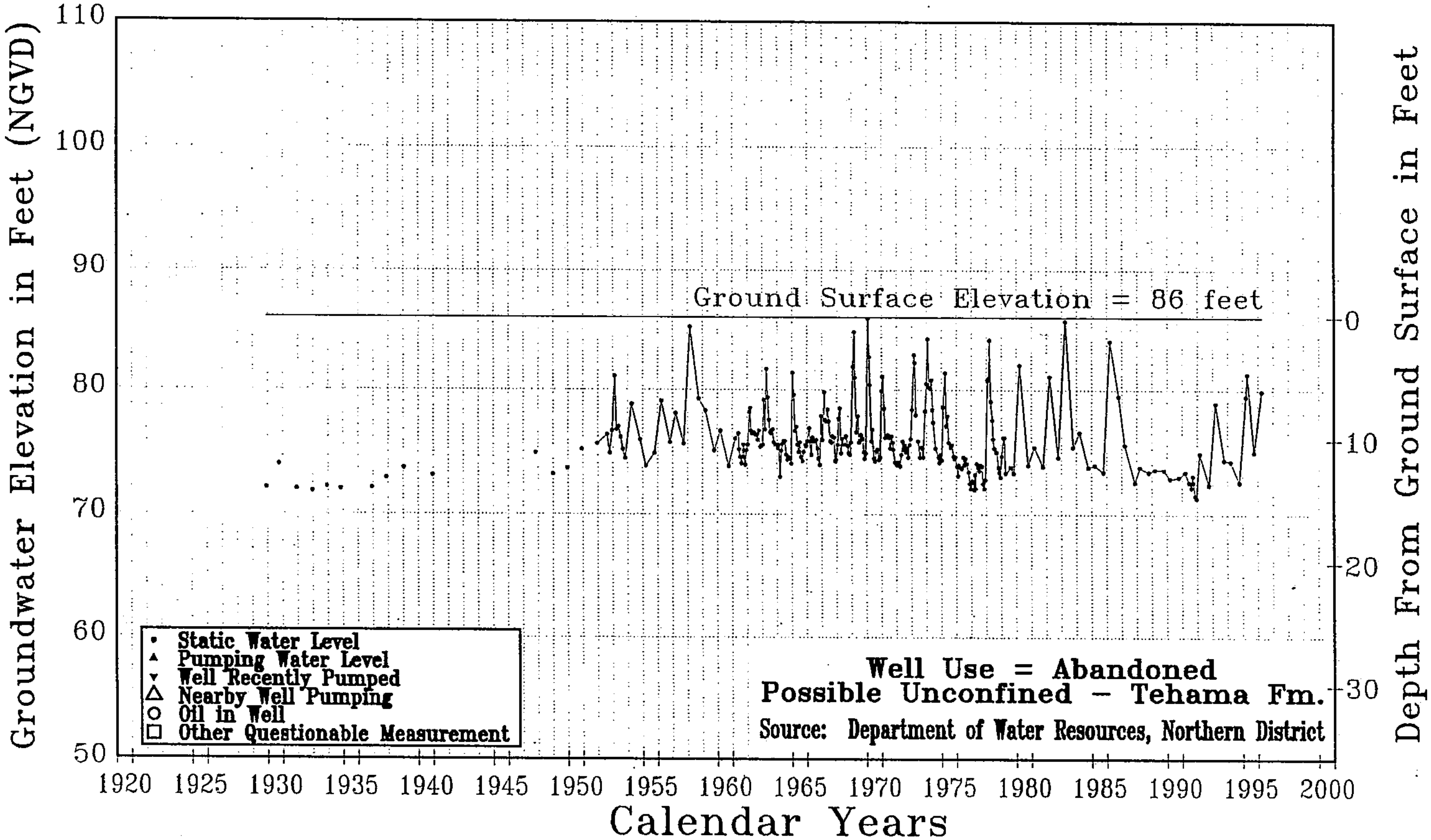
APPENDIX C4
GLENN COUNTY GROUNDWATER LEVEL HYDROGRAPHS IN THE PID AREA



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF LOCAL ASSISTANCE

WELL HYDROGRAPH FOR 19N/02W-09A01M

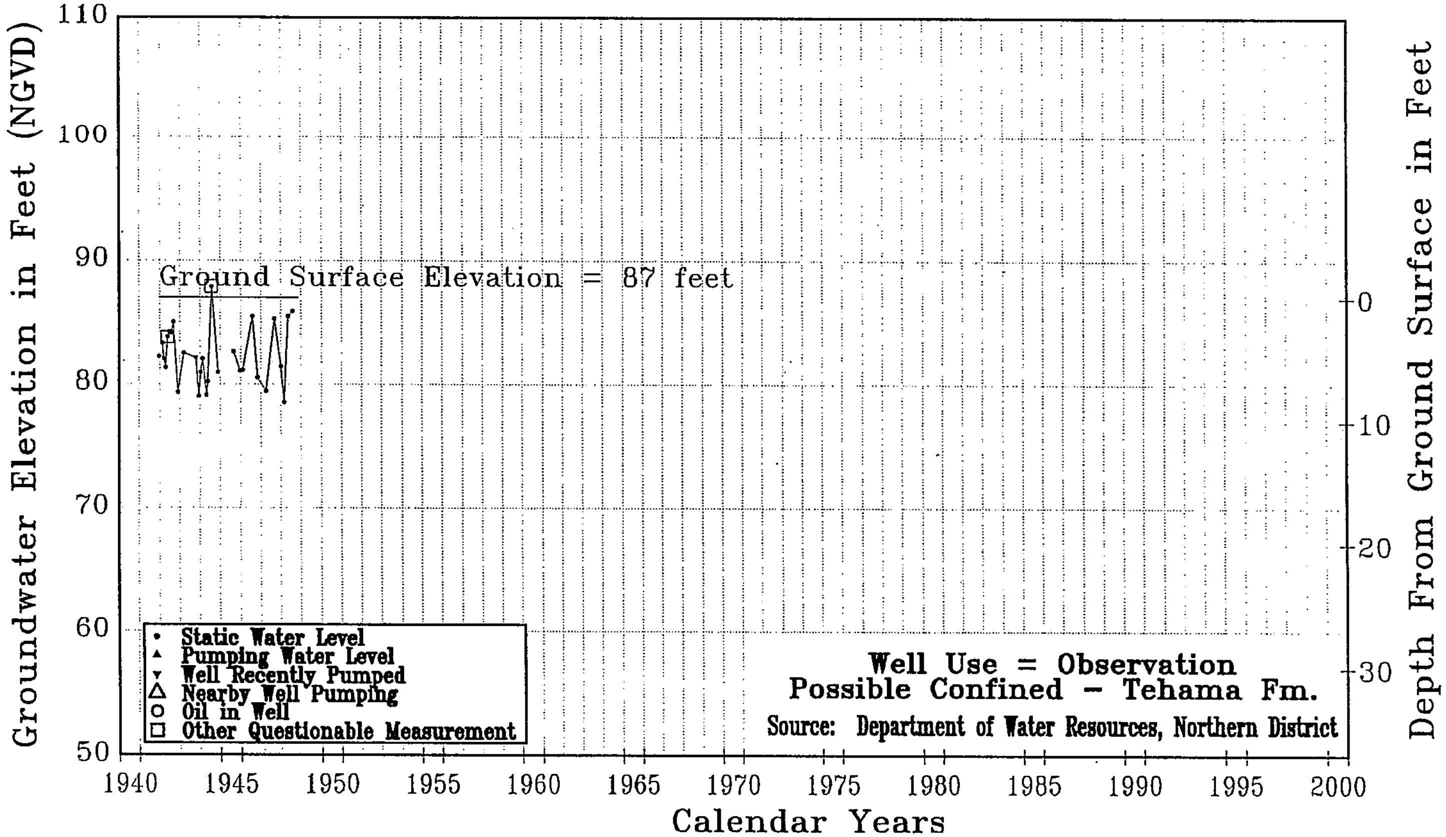
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF LOCAL ASSISTANCE
NORTHERN DISTRICT

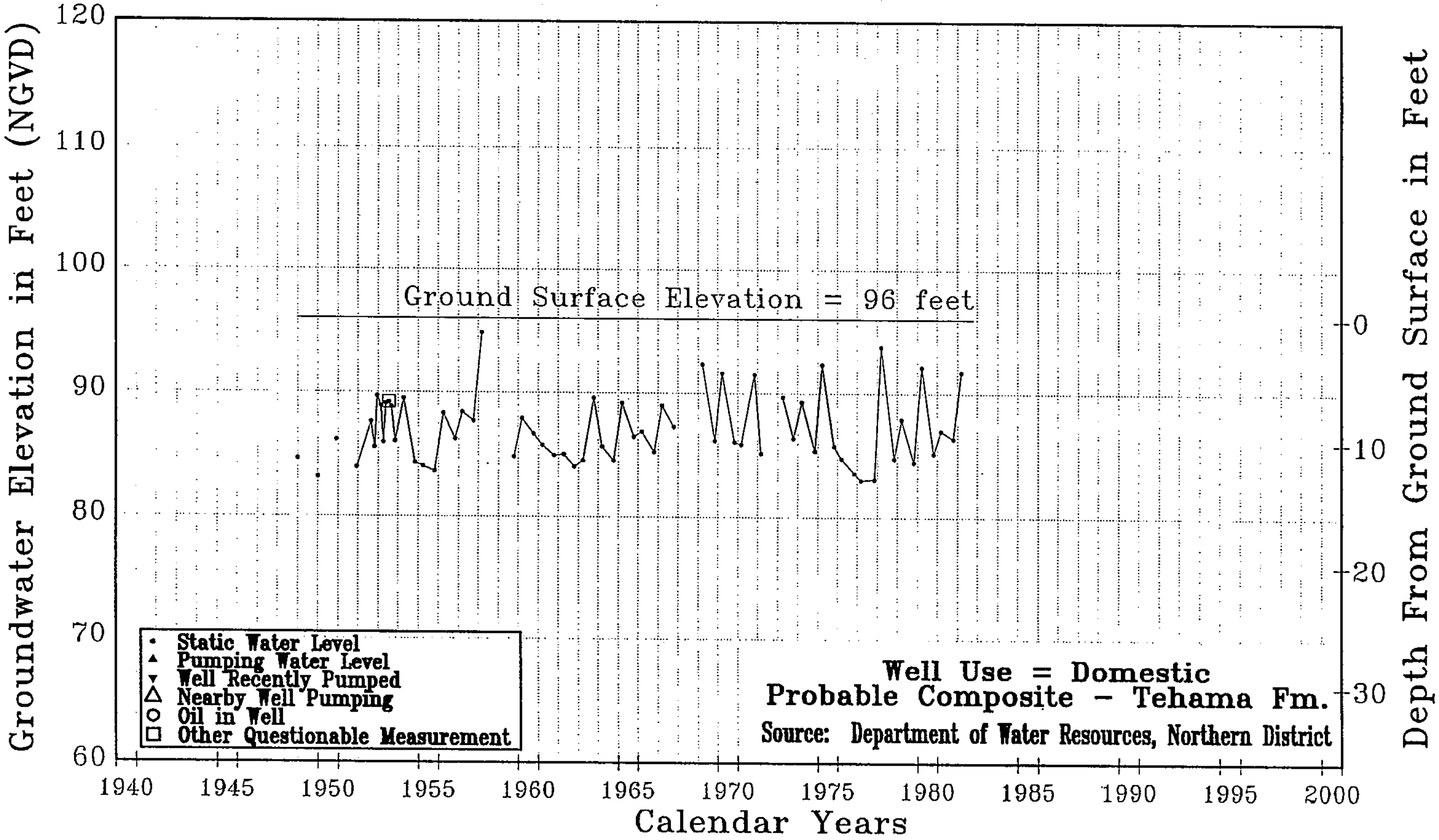
WELL HYDROGRAPH FOR 19N/02W–13J01M

PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF LOCAL ASSISTANCE

WELL HYDROGRAPH FOR 19N/02W-23Q01M
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY



STATE OF CALIFORNIA
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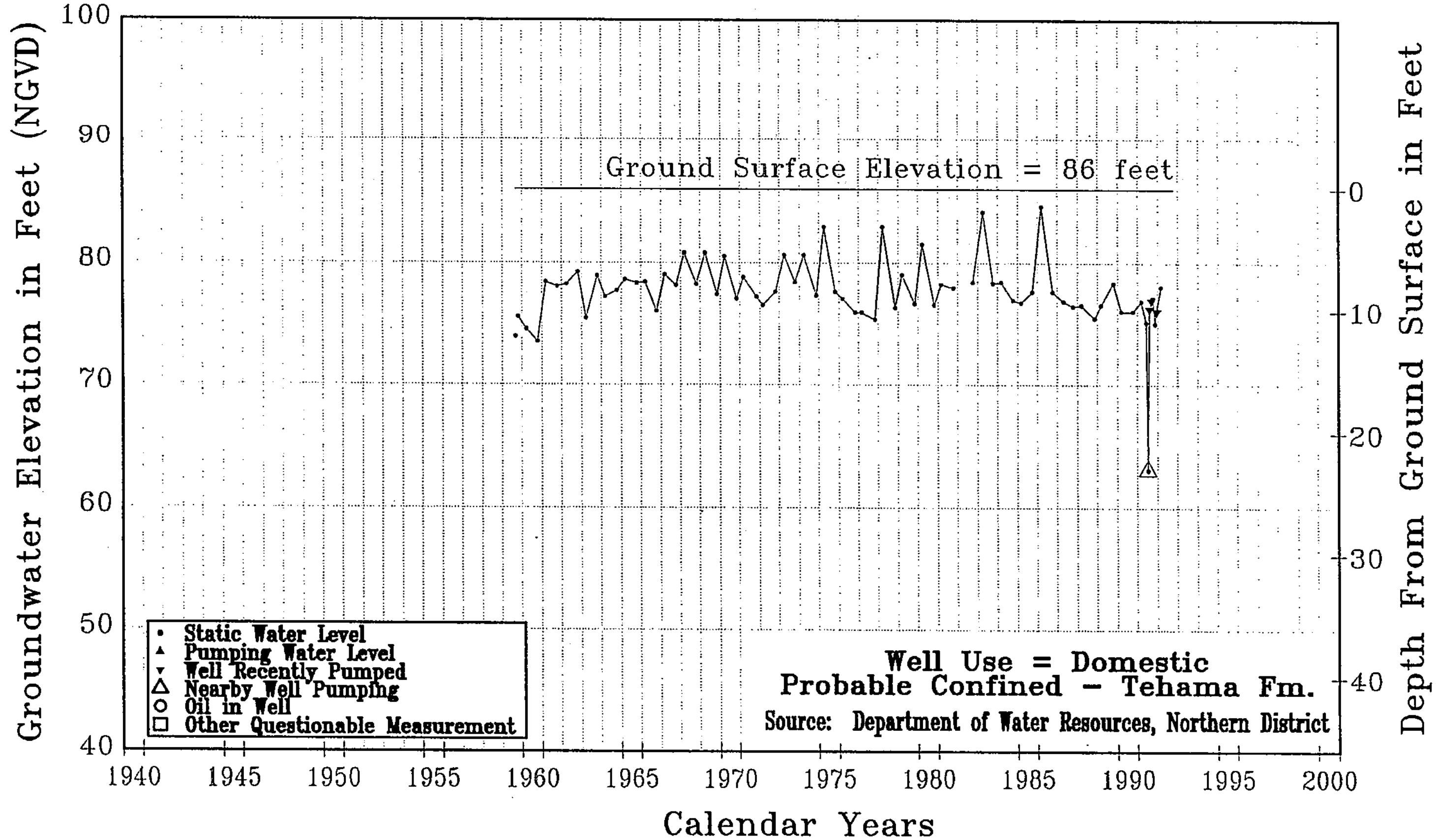
DEPARTMENT OF WATER RESOURCES
DIVISION OF LOCAL ASSISTANCE

WELL HYDROGRAPH FOR 20N/01W-31E01M
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY



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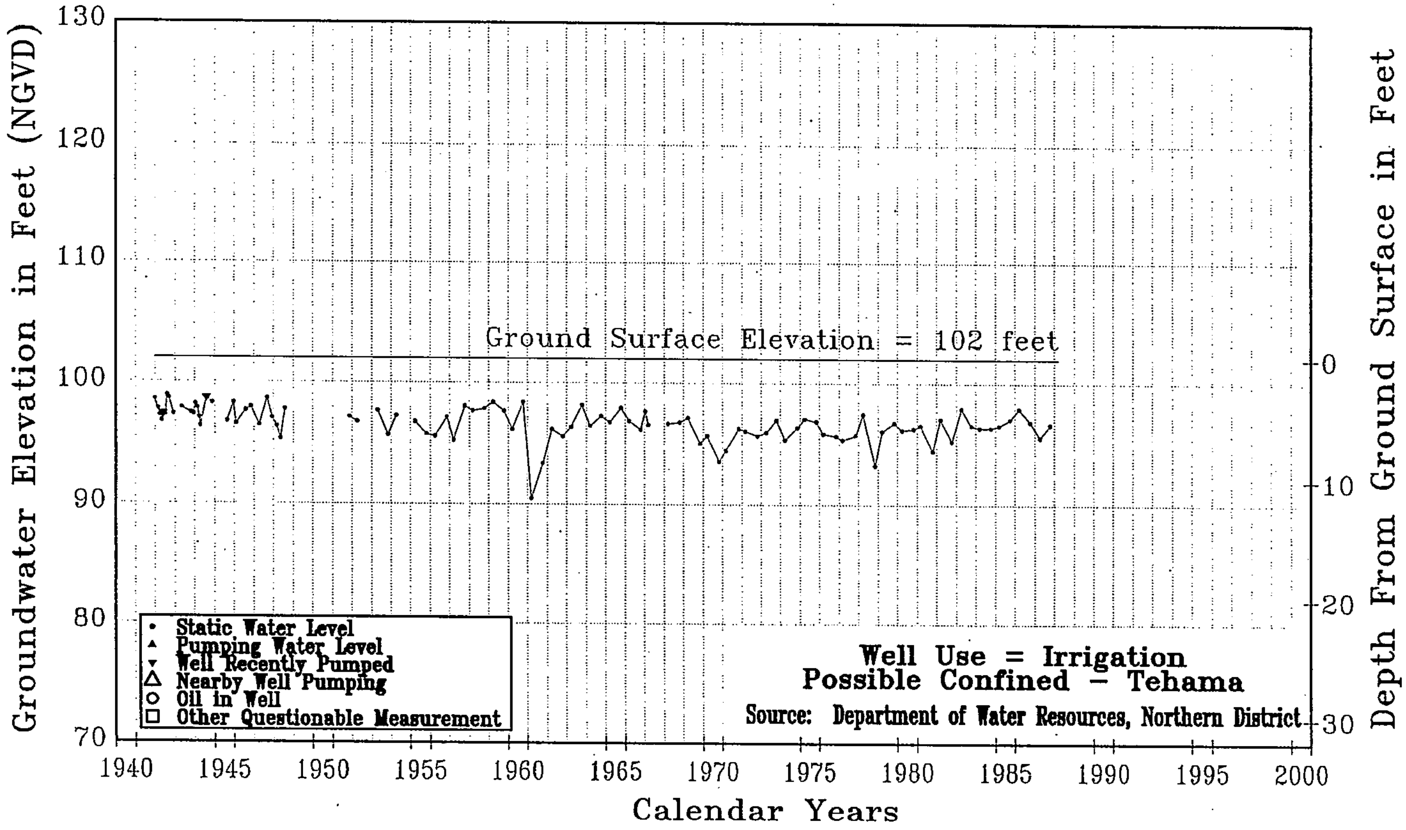
DEPARTMENT OF WATER RESOURCES
DIVISION OF LOCAL ASSISTANCE

WELL HYDROGRAPH FOR 19N/02W-23Q02M

PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY



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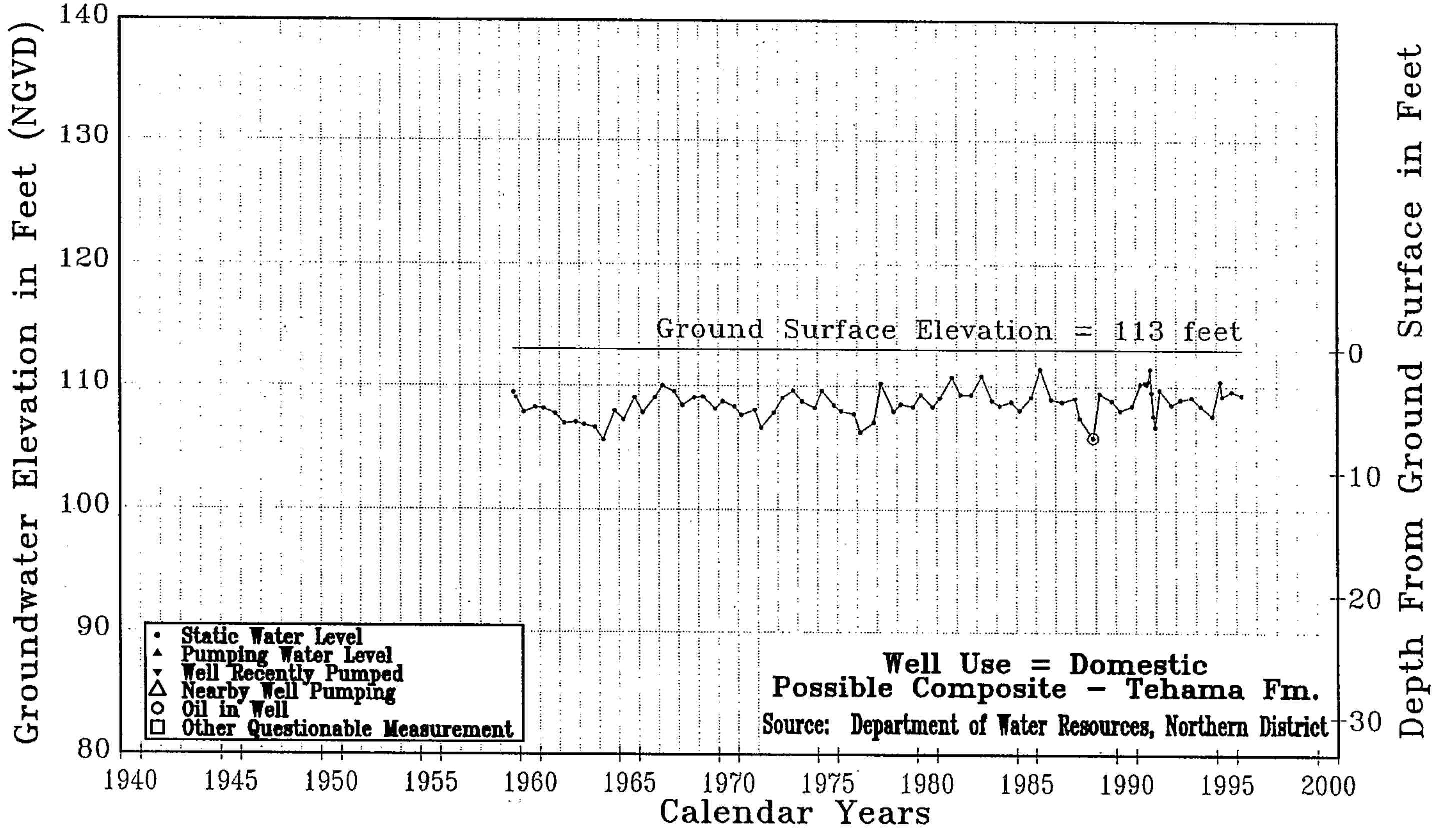
DIVISION OF LOCAL ASSISTANCE

WELL HYDROGRAPH FOR 20N/02W-27J01M
PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY



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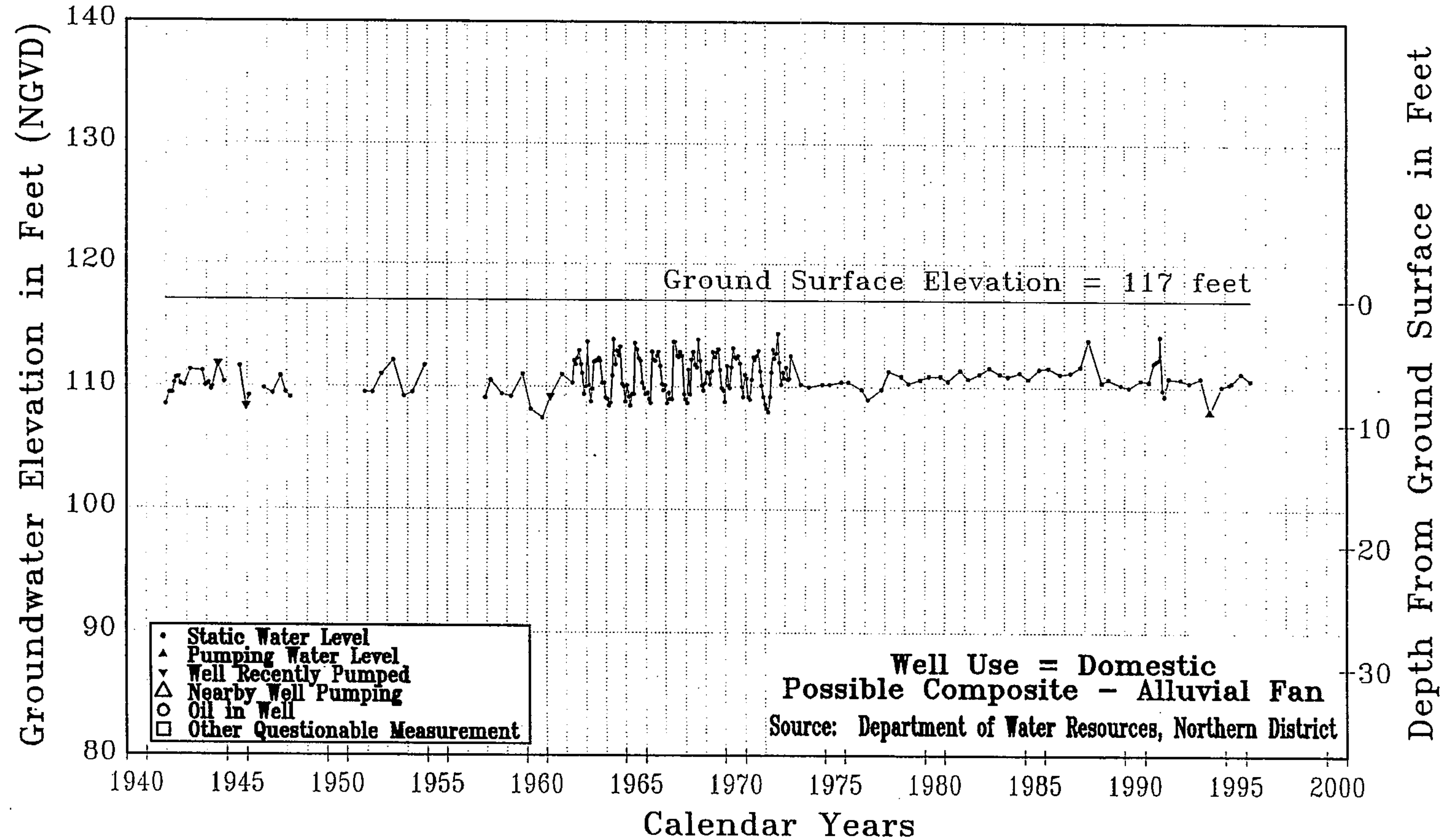
DIVISION OF LOCAL ASSISTANCE

WELL HYDROGRAPH FOR 20N/02W-13G01M

PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY



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DIVISION OF LOCAL ASSISTANCE

WELL HYDROGRAPH FOR 20N/02W-29G01M

PROVIDENT IRRIGATION DISTRICT CONJUNCTIVE USE STUDY

APPENDIX D
PRINCIPLES OF HYDROGEOLOGY

PRINCIPLES OF HYDROGEOLOGY

This section provides an overview of some basic principles of hydrogeology such as groundwater occurrence, ground water movement, the impacts of pumping, and the physical properties which characterize an aquifer. Geohydrologic principles and terminology presented in this section are a reference for the discussions on the hydrogeology of Provident Irrigation District.

Groundwater Hydrology

Groundwater comprises 98 percent of the world's available fresh water supply. From the time a drop of water enters the ground, to the time it leaves, its movement and storage are governed by the physical and chemical properties of the water, and its surrounding environment. Like most substance which behave according to the laws of physics, groundwater seeks a state of equilibrium, flows along the path of least resistance, and collects in low energy environments.

Most of the materials that make up the earth's outer crust have open spaces that may contain groundwater. The openings range from minute pores in clays, to large cracks and passages found in some basalt and limestone aquifers. The percentage of empty space in a material is referred to as ***porosity***. Porosity does not indicate an ability to transmit, or move ground water through a material. The rate at which water can transmit through a material is referred to as ***permeability***. High porosity within a material does not necessarily imply high permeability. If the openings are very small, or are not connected, water movement is restricted and the material is said to have a low permeability and high porosity. For example, materials such as clay have a high porosity, yet transmit little water to wells. In contrast, materials of high permeability but somewhat lower porosity, such as mixtures of coarse gravel and sand, can yield large amounts of groundwater.

As water enters the ground and moves downward, it passes through an upper zone of unsaturated, and partially saturated material. This zone is called the ***zone of aeration, (Figure D-1***). The zone of aeration is commonly divided into three subzones called: soil water subzone, intermediate subzone, and capillary subzone. Under normal conditions, the intergranular pore spaces become increasingly saturated as water infiltrates from the soil water subzone to the capillary subzone. Saturated conditions may occur throughout the entire zone of aeration due to infiltration from heavy rainfall or irrigation waters. Although temporary conditions, or isolated areas ("perched" water tables), may produce saturated intervals within the zone of aeration, in general, wells cannot produce groundwater from this zone.

In the lower zone, the intergranular spaces in the underground materials are interconnected and filled with groundwater. This zone is called the ***zone of saturation***. In the zone of saturation, groundwater exists under unconfined and confined conditions. Widespread impervious layers often overlay areas of confined groundwater. The water table is the upper surface of the water in the unconfined saturated zone. In a confined saturated zone, the water table is defined as the level to which water will rise in a well, or the potentiometric surface. Both confined and unconfined groundwater can be recharged from direct precipitation and surface runoff.

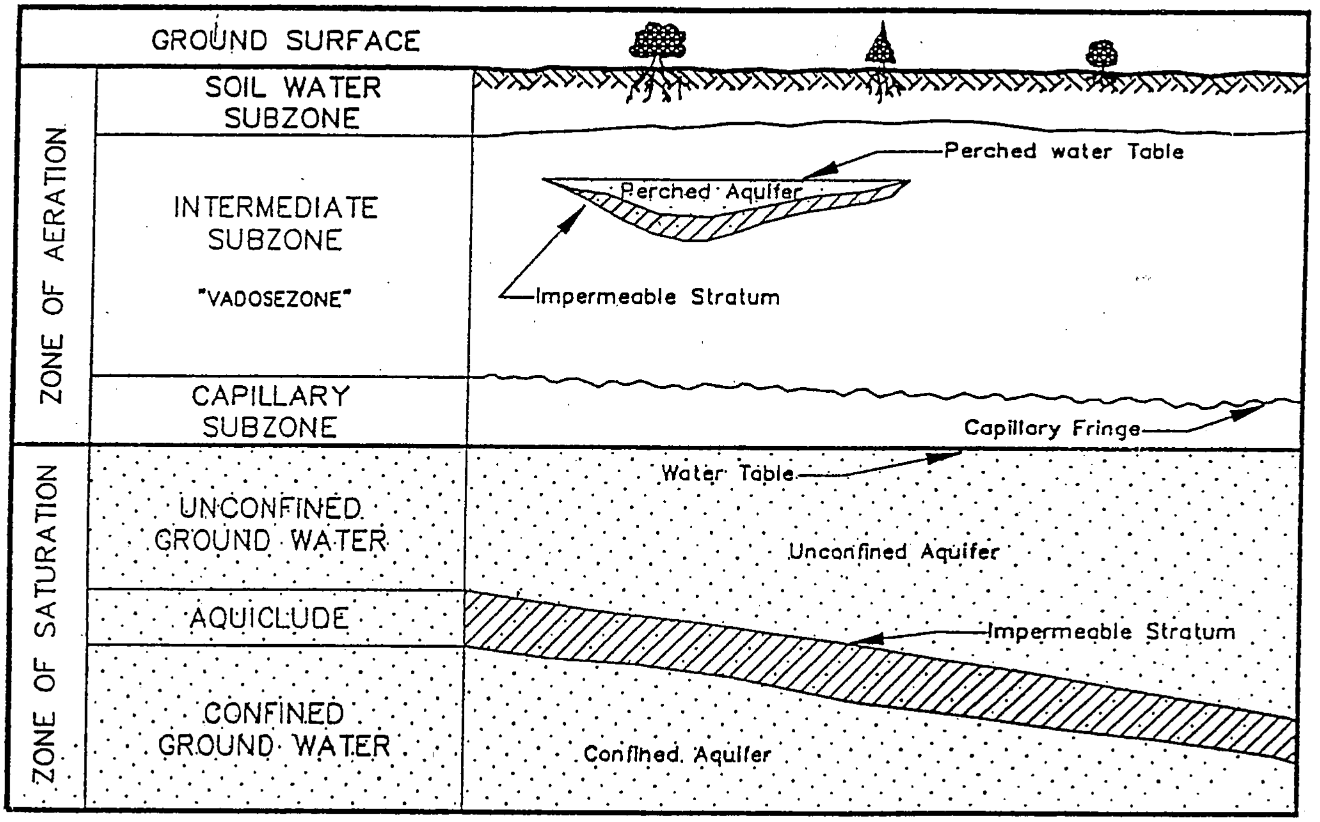

Figure D-1 -- Zone of Aeration/saturation

Groundwater resources are replenished when water from precipitation, stream flow, irrigation, etc., penetrates into the ground. Areas which are conducive to the replenishment of groundwater are called ***recharge areas***. In general, recharge areas consist of permeable deposits along the basin perimeter, on mountains and foothill slopes, and within the basin adjacent to major streams and tributaries. The alluvial deposits on the valley floor are often hydrologically connected to rivers and the streams resulting in rapid infiltration of surface waters.

Areas which are characterized by a shallow groundwater table (thin zone of aeration), surface seepage and groundwater springs are called ***discharge areas***. Groundwater discharge areas commonly occur in topographic lows.

Aquifers, Aquifer Systems and Geohydrologic Units

Aquifer is a general term used to describe the rock or sediments within the zone of saturation which have sufficient permeability to transmit economic quantities of water to wells and/or springs. In some regions it is common to have several aquifers, which together, characterize the ***aquifer system*** for the area or region. Aquifers may also be grouped or classified according to similar water-bearing geologic units, or ***geohydrologic units***. Within an aquifer system, a single geohydrologic unit may consist of an ***unconfined aquifer***, and one or more ***confined*** or ***composite aquifers.*** Also, within each confined and semi-confined aquifer, there may be numerous ***zones*** of variable permeability and hydrostatic pressure.

Groundwater Movement

Groundwater moves from areas of higher elevation to areas of lower elevation, or from areas of recharge to areas of discharge. The distribution and movement of groundwater may be determined by constructing a map showing groundwater elevations. Groundwater elevation contours commonly follow the topography of the land surface and water flows at right angles to the elevation contours. The rate of groundwater movement is typically slow, from a few feet, to a few thousand feet per year. Pumping can create a temporary depression in the water table, causing a change in the direction and rate of groundwater movement.

Physical barriers (faults, impervious rock, etc.,) may impede the movement of groundwater. These barriers may be indicated by the pattern and spacings of the groundwater contours. Faulting often displaces water-bearing units, forming a groundwater dam. The groundwater dam will reveal itself as a sudden change in the water table and associated groundwater elevation contours, or as the development of springs along the ground surface.

Impacts of Pumping

When a well is pumped, the water level around it is drawn down to form an inverted cone with its apex at the well. The area of drawdown created by pumping is called the ***cone of depression*** **(Figure D-2)**. The size of the cone depends on the quantity and rate of water being pumped ***(discharge)***, and how fast water can flow through the aquifer to replenish the well ***(transmissivity)***. As pumping continues, the cone expands in depth and area until it reaches equilibrium between pumping demand and aquifer yield.

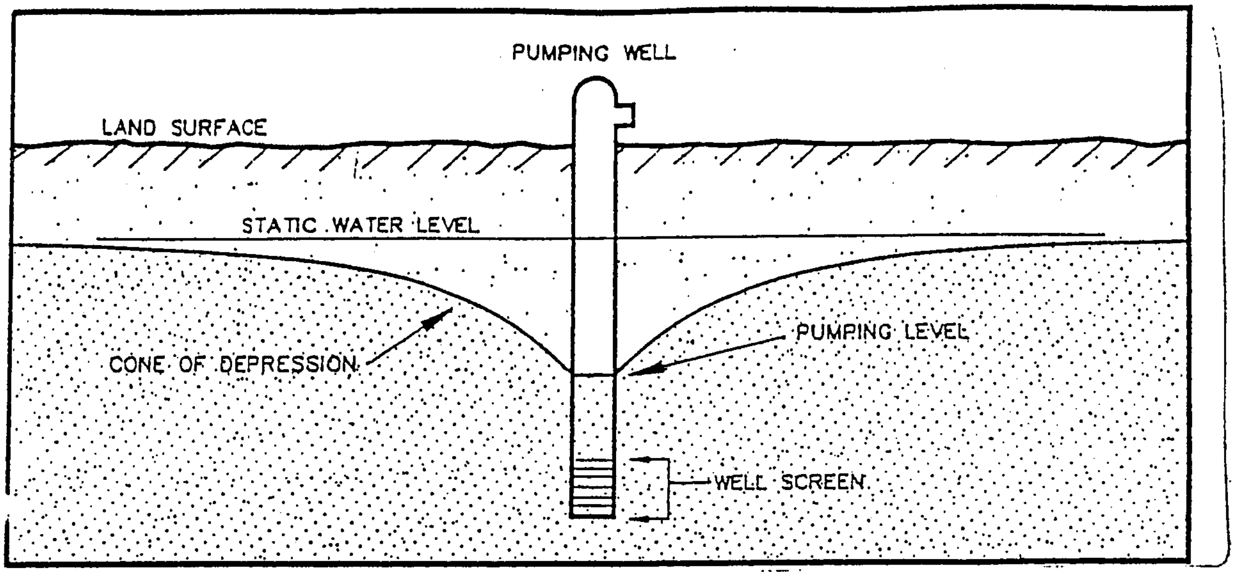

Figure D-2. Cone of depression caused by pumping wells.

Where the amount of water pumped from an aquifer is greater than aquifer yield, water levels will continue to decline. In areas experiencing extensive use of groundwater or having closely spaced high production wells, the cone of depression for several pumping wells may overlap. If managed properly, groundwater depressions from pump interference can remain localized, and recovery may be optimized once demand decreases. If poorly managed, the cumulative effects of well interference can produce a regional depression, with an extended period of recovery. ***Figure D-3*** illustrates the effects of this interference among pumping wells. The extent of interference depends on the pumping rates, the well spacing, and the hydraulic properties of the affected aquifer.

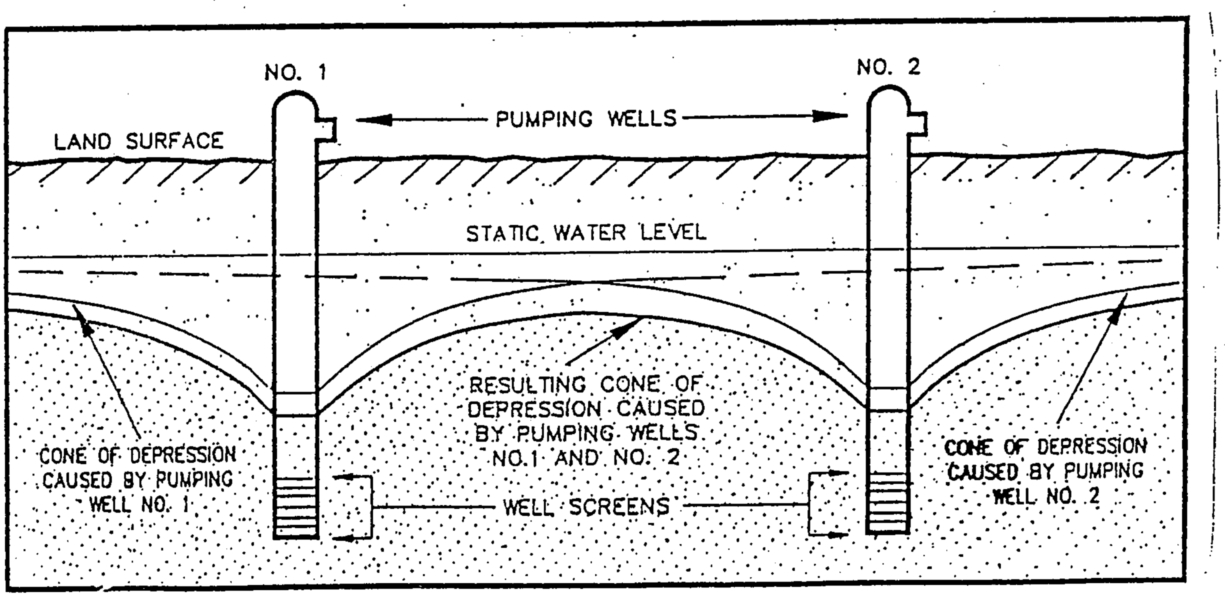

Figure D-3. Effects of interference between two pumping wells.

Aquifer Parameters

Groundwater parameters describe the physical properties of an aquifer that determine movement and storage. They can be used to predict the effects of water levels due to pumping and recharge.

Transmissivity is the capacity of the aquifer to transmit water through its pore spaces. Transmissivity is the rate of flow moving through the entire saturated thickness having a width of one foot, under a unit hydraulic gradient. The units of transmissivity are gallons per day per foot (gpd/ft) or cubic feet per minute per foot. Transmissivity is most commonly determined through aquifer testing, but may also be calculated as the product of aquifer thickness and hydraulic conductivity. Thus, the transmissivity can vary within a given aquifer of uniform composition due to variation in aquifer thickness.

Hydraulic Conductivity is similar to transmissivity in that it also describes the rate at which water can move through a permeable material. However, hydraulic conductivity does not take into account the thickness of the material. Thus, hydraulic conductivity is commonly used to characterize the movement of water at a smaller scale, i.e., within an individual sample or bed, rather than an aquifer as a whole.

Storativity is a dimensionless unit that represents the volume of water released from or added to storage per unit surface area of the aquifer, per unit change in head. For most confined aquifers, storage coefficients range from 0.00001 to 0.001. For most unconfined aquifers, the storage coefficient ranges from 0.1 to 0.3, and is equivalent to the specific yield.

Specific Yield is the ratio of the volume of water a material will yield, under gravity drainage, to the total volume of the material. For unconfined aquifers, specific yield is equivalent to storativity.

Specific Capacity is the yield per unit drawdown of a production well. It is often used to estimate transmissivity where no aquifer test information is available. The specific capacity is a function of well construction (i.e. location of perforated zones, well efficiency), pumping rate and duration, and aquifer characteristics (i.e. aquifer thickness, storage coefficient, and transmissivity of the producing zone). Because specific capacity incorporates a drawdown value with the yield of a well, it is much more meaningful than just the yield. Also, theoretically, the specific capacity of a well with a given pump size should not change. Therefore, if the specific capacity changes with time, then the well or the aquifer is experiencing changes - not the pumping equipment. For example, if the specific capacity of a well decreases with time, a likely cause is clogging of well perforations.